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United States Department of the Interior

GEOLOGICAL SURVEY
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DENVER, COLORADO 80225



IN REPLY REFER TO:

Branch of Sedimentary Processes

June 4, 1993

Dear Bill,

Well, I have been disgusting silent and unproductive these past several months. I guess it's time for me to get back on the stick and get some things accomplished. Actually, in all seriousness I have been doing a lot of probe work. Unfortunately, a lot of it has been simply "working on the probe" rather than in a data collection mode. The good news is that all of the work has been on the brand new probe and I am one of the few "expert" users. Of course, that hasn't gotten us much data. Actually, I have been able to get some real good sulfide data off of the probe--I got the sulfide code working very well about 2 months ago! Of course, I couldn't deal with success so what did I do--squandered the last two months of probe time trying to set up a uranium code. Ugh. Of course, no one but me cares about uranium (not totally true--the past month Gene Foord has been interested so that has been a help). I am getting no help from the probe operator, so I have been totally on my own trying to work out element interferences, backgrounds, looking up wavelengths, etc. Nevertheless, this is a uranium mine so it would be nice to have some probe analyses on the uraninite!! No one has actually done any analyses of the uranium, to my knowledge. I am on again on June 24th and I think I have the code almost ready to go! Hopefully!

Back in January I put together an abstract on Ni-Co sulfides and arsenides for GSA and it got accepted for the Rocky Mt/Cordilleran joint GSA meeting in May. So, that kept me busy for the past month. Now that I'm back from presenting the paper I have some time to get organized and hopefully work on the mineralogy sections. I have two more probe days before we take our Lake Powell trip (we are only doing one this year). So, I believe I will complete them and then try and get some writing done. I can always modify it with later data if I have to, but if I poke around too long on this I will begin to be like Gil Bowles and never get it published. I have enclosed a xerox of my data file in it's present state. I had hoped to get more of the stoichiometry worked out before I mailed it to you. I finished with all of the pyrite group minerals, but I have a lot of work to do on the copper group minerals yet, so you will see many samples don't have a mineral name. You will also note that there are two tables of the same samples--one is the actual weight % data that one gets from the analysis and the other is the atomic percent that is needed to figure out what mineral is present. Also enclosed are some plots of the data for the various groups of minerals--primarily for the ones that I gave in my talk. I at least wanted to keep you up to date on what I have been doing.

Also, enclosed are copies of some letters I just wrote off to various people with the Park Service. I thought it was time to stir the pot a bit--I know they hope that you and I will just go away if they ignore us. They don't know us very well. I agree with you that I don't think our proposal to Ellis Richards is going to go very far. Anyway, I realize that I never sent you a copy

of it, so here it is, and thanks a lot for working it up. I noticed that they didn't ask for a budget, so I simply xeroxed the one that we had enclosed with the letter to Ms. Pepin-Donat last December. Hopefully, we will get a better response than your letter to Babbitt brought. In fact, I was down right disappointed in the response. He never said anything to address whether they would not tear down the headframe. So, lets see what happens. I have long since learned in my life that persistence eventually pays off! (usually)

Have you ever heard from Matt. I have received several phone calls from Larry Casebolt in Kanab, Arizona. He is (was--guess you can't be a mine geologist when no mines are open!) their mine geologist, who is still on their staff in Arizona. He's always been a good contact and he is working on getting some samples together for me from the Arizona 1 mine--it's the only one of their mines that I don't have a single ore sample from. Anyway, I asked him if Matt was still around when he called me a day ago and he said he was.

Bill and I just set our dates for our Lake Powell trip this summer, so I hope they fit in with your schedule because it would be a great time to force us to get some more work done--a deadline for us to exchange progress and go over new text! We are planning to leave Denver on July 10th and return from Lake Powell on July 24th. I would suggest that we could have a brief visit on our way to the lake where you and I could exchange pages of text, tables, figures, etc., and then we would both have 2 weeks to go over each others info, and then get in several hours of work on our way back on the 24th in the afternoon.

Let me know how things are going and how my suggestions fit in with your plans. Also, any comments suggestions, etc. that you have on my probe work would be greatly appreciated. I hope all of my correspondence to the Park Service looks okay to you.

Sincerely,



350' 991-G ✓
 245-E ✓
 450' 991-I-C85 ✓

P
 P
 Microprobe
 work
 on partially done

August 11, 1993

Polished Section
 Polished Slab
 Round block

Geochemical analyses of Orphan Mine Samples

Bills#

Level	Field ID	Lab No.	Latitude	Longitude	Job number	Fm. Code	Ag ppm AA	Ag ppm ICP	Al % ICP	Al2O3 % XRF	As ppm AA	As ppm ICP	Au ppm AA
350'	991-G-C85 ✓	D-272100	36.079167	112.155556	RZ03	7.0	—	73.	0.97	(H) 1.81 #124	—	12000.	<0.10
240'	991-B-C85 ✓	D-272109	36.079167	112.155556	RZ03	5.0	—	6.0	0.62	(H) 1.29 #125	—	2900.	<0.10
?	991-K-C85 ✓	D-272111	36.079167	112.155556	RZ03	5.0	—	9.0	0.92	(H) 1.60 #131	—	1200.	—
310'	991-J-C85 ✓	D-272114	36.079167	112.155556	RZ03	5.0	—	2.0	1.00	1.82 #123	—	230.	0.40
310'	991-F-C85 ✓	D-272115	36.079167	112.155556	RZ03	5.0	—	58.	0.98	(H) 1.75 #132	—	740.	<0.10
310'	991-D-C85 ✓	D-272117	36.079167	112.155556	RZ03	5.0	—	34.	1.1	1.97 #127	—	30.	<0.10
450'	991-I-C85 ✓	D-272119	36.079167	112.155556	RZ03	5.0	—	180.	0.84	(H) 1.73 #130	—	420.	<0.10
310'	991-E-C85 ✓	D-272121	36.079167	112.155556	RZ03	5.0	—	40.	5.5	10.5 #128	—	<10.	<0.10
450'	991-H-C85 ✓	D-272122	36.079167	112.155556	RZ03	5.0	—	74.	1.5	2.79 #129	—	<10.	<0.10
0	991-W-C87 ✓	D-283237	36.079167	112.155556	SJ42	0.0	—	13.	0.56	(H) 1.31	—	3800.	—
	991-R-C87 ✓	D-283238	36.079167	112.155556	SJ42	0.0	—	<4.0	1.00	2.20	—	1200.	—
	991-S-C87 ✓	D-283240	36.079167	112.155556	SJ42	0.0	—	7.0	0.61	(H) 1.36	—	3700.	—
	991-T-C87 ✓	D-283241	36.079167	112.155556	SJ42	0.0	—	<4.0	4.1	(H) 8.07	—	900.	—
	991-U-C87 ✓	D-283242	36.079167	112.155556	SJ42	0.0	—	7.0	0.48	(H) 1.23	—	3700.	—
	991-245-2	D-375857	36.074444	112.154167	UM20	3.0	—	120.	0.80	H-	—	9400.	NO.05
	991-585-33B ✓	D-375858	36.074444	112.154167	UM20	2.8	—	21.	0.59	1.26	—	1900.	NO.05
	991-245-9 ✓	D-375859	36.074444	112.154167	UM20	3.0	—	<4.0	0.86	1.54	—	140.	NO.05
	991-320-4 ✓	D-375905	36.074444	112.154167	UM25	3.0	—	6.0	0.70	1.33	—	450.	NO.05
	991-320-8	D-375906	36.074444	112.154167	UM25	3.0	—	300.	0.71	H-	—	460.	NO.05
	991-245-4B	D-375907	36.074444	112.154167	UM25	3.0	—	41.	1.00	H-	—	710.	NO.05
	991-350-1 ✓	D-375908	36.074444	112.154167	UM25	3.0	—	26.	0.84	H-	—	900.	NO.05
	991-400-R4	D-375909	36.074444	112.154167	UM25	2.8	—	98.	2.2	H-	—	23000.	0.05
	991-365-3 ✓	D-375910	36.074444	112.154167	UM25	3.0	—	21.	0.87	H-	—	9700.	NO.05
	991-365-1	D-375911	36.074444	112.154167	UM25	3.0	—	10.	4.2	H-	—	6400.	NO.05
	991-245-4A	D-375912	36.074444	112.154167	UM25	3.0	—	61.	0.88	H-	—	740.	NO.05
	991-320-7 ✓	D-375913	36.074444	112.154167	UM25	3.0	—	<4.0	0.81	1.67	—	50.	NO.05
	991-585-33A ✓	D-375914	36.074444	112.154167	UM25	2.8	—	<4.0	2.7	5.26	—	210.	NO.05
	991-350-365 ✓	D-375915	36.074444	112.154167	UM25	3.0	—	<4.0	0.71	1.89	—	120.	NO.05
	991-245-11C ✓	D-375916	36.074444	112.154167	UM25	3.0	—	<4.0	1.4	2.66	—	<20.	NO.05

430-5-65 ✓
 430-4B-65 ✓ (2)

(ump) - 991-A-C84 ✓
 240' 991-B'-C85 ✓ (Bills# 125)
 310' 991-C-C85 ✓ (#126)
 " 991-D-C85 ✓ "
 310' 991-D'-C85 ✓ (#127)
 310' 991-E'-C85 ✓ (#128)
 310' 991-F'-C85 ✓ (#132)
 320 ✓

P

August 11, 1993

Polished Section

Round block

microprobe

Level	Field ID	Lab No.	Latitude	Longitude	Job number	Fm. Code	Ag ppm AA	Ag ppm ICP	Al % ICP	Al2O3 % XRF	As ppm AA	As ppm ICP	Au ppm AA
	991-375-D-1 ✓	D-375917	36.074444	112.154167	UM25	3.0	—	<4.0	2.1	4.20	—	<20.	NO.05
	991-400-30 ✓	D-375918	36.074444	✓112.154167	UM25	2.8	—	<4.0	0.78	—	—	1500.	NO.05
	991-265-1	D-375919	36.074444	✓112.154167	UM25	3.0	—	110.	1.3	—	—	2400.	NO.05
	991-245-10 ✓	D-375920	36.074444	112.154167	P UM25	3.0	—	6.0	0.38	—	—	3700.	NO.05
	991-265-1R	D-375921	36.074444	112.154167	UM25	3.0	—	90.	1.8	—	—	1900.	NO.05
	991-350-21	D-375922	36.074444	✓112.154167	P UM25	3.0	—	110.	1.00	—	—	23000.	NO.05
	991-245-5	D-375923	36.074444	✓112.154167	P UM25	3.0	—	58.	8.4	—	—	8400.	NO.05
	991-400-R1	D-375924	36.074444	112.154167	UM25	2.8	—	230.	0.99	—	—	5300.	NO.05
	991-0-2	D-375925	36.074444	✓112.154167	UM25	4.0	—	65.	0.96	—	—	210.	NO.05
	991-365-Y ✓	D-375926	36.074444	112.154167	UM25	3.0	—	4.0	0.84	—	—	670.	NO.05
	991-175-1 ✓	D-375927	36.074444	112.154167	P UM25	3.0	—	<4.0	0.80	1.49	—	78.	NO.05
	991-320-1 ✓	D-375928	36.074444	112.154167	UM25	3.0	—	<4.0	1.7	3.34	—	<20.	NO.05
	991-525-33 ✓	D-375929	36.074444	112.154167	UM25	2.8	—	23.	0.48	—	—	3900.	NO.05
	991-365-X ✓	D-375930	36.074444	112.154167	UM25	3.0	—	7.0	0.96	1.87	—	440.	NO.05
	991-00-1 ✓	D-375931	36.074444	112.154167	P UM25	4.0	—	<4.0	1.3	—	—	710.	NO.05
	991-320-6 ✓	D-375932	36.074444	112.154167	UM25	3.0	—	<4.0	0.69	1.30	—	43.	NO.05
	991-365-XR	D-375933	36.074444	112.154167	UM25	3.0	—	8.0	1.00	1.96	—	480.	NO.05
	991-400-R3 ✓	D-375934	36.074444	112.154167	P UM25	2.8	—	10.	1.1	—	—	960.	NO.05
	991-225-4 ✓	D-375935	36.074444	112.154167	UM25	0.0	—	150.	0.65	—	—	210.	NO.05
	991-265-2 ✓	D-375936	36.074444	✓112.154167	UM25	3.0	—	7.0	0.36	—	—	3000.	NO.05
	991-365-910 ✓	D-375937	36.074444	112.154167	UM25	3.0	—	24.	3.3	—	—	1100.	NO.05
	991-585-34 ✓	D-375938	36.074444	✓112.154167	P(PS) UM25	2.8	—	45.	0.29	—	—	19000.	0.05
	991-320-2 ✓	D-375939	36.074444	112.154167	UM25	3.0	—	<4.0	2.1	4.58	—	110.	NO.05
	991-0-3B ✓	D-375940	36.074444	112.154167	P UM25	4.0	—	<4.0	5.6	10.8	—	40.	NO.05
	991-245-11 ✓	D-375941	36.074444	112.154167	UM25	3.0	—	4.0	0.91	1.75	—	180.	NO.05
	991-320-8R	D-375942	36.074444	112.154167	UM25	3.0	—	280.	0.66	—	—	450.	NO.05
	991-350-2 ✓	D-375943	36.074444	112.154167	UM25	3.0	—	<4.0	4.3	8.31	—	190.	NO.05
	991-585-32 ✓	D-375944	36.074444	112.154167	UM25	2.8	—	4.0	1.2	—	—	1400.	NO.05
	991-400-1R	D-375945	36.074444	112.154167	UM26	0.0	—	4.0	0.04	—	—	1800.	NO.05

150' - 991-H1-C85 ✓ #129

(outer annular ring) - 991-J1-C85 ✓ #123

100 - 991-M-C86 ✓ -

400 - 991-O-C86 ✓ -

400 - 991-O1-C86 ✓ -

? - 991-P-C86 ✓

175' - 991-Q-C86 ✓

Dump 991-Dump1 ✓

August 11, 1993

Microprobe work
Done on partially
done

Thin Section
Polished Slab
Round Block

Level	Field ID	Lab No.	Latitude	Longitude	Job number	Fm. Code	Ag ppm AA	Ag ppm ICP	Al % ICP	Al2O3 % XRF	As ppm AA	As ppm ICP	Au ppm AA
	991-0-3A	D-375946	36.074444	112.154167	UM26	0.0	—	20.	0.47	-H-	—	6100.	NO.05
	991-190-1	D-375947	36.074444	112.154167	UM26	0.0	—	20.	0.03	-H-	—	1700.	NO.05
	991-400-1	D-375948	36.074444	112.154167	P UM26	0.0	—	6.0	0.07	-H-	—	2900.	NO.05

Dump 991-Div 2 ✓
 245-4 ✓
 245-0-2 ✓
 585-3 ✓
 0-3A ✓ D
 245-1 ✓
 365-2 ✓ D
 365-15 ✓
 400-2 ✓
 430-4A ✓
 585-33 ✓
 400 R2 ✓
 550-2 ✓
 585-31-64 ✓ (2)
 1000/3557 ✓
 1190/5630 ✓
 1090/6630 ✓
 760/5680 ✓
 900/5658 ✓
 1150/5480 ✓ (2) P
 8' ✓
 6' ✓
 5' ✓
 7' ✓
 11' ✓ P
 9' ✓
 5' ✓
 12' ✓
 4' ✓
 8' ✓ P

Garnitz

Microprobe Analyses - Orphan Mine Samples - Atomic proportions

Sample #	Mineral	S prop	Mn prop	Fe prop	Co prop	Ni prop	Cu prop	Zn prop	As prop	Mo prop	Ag prop	Pb prop	V prop	Se prop	Cd prop	Sb prop
24510a01	pyrite	1.6165		0.7417		0.0172	0.0382		0.0072	0.0068		0.0007				
24510a02	pyrite	1.6264		0.8056					0.0155	0.0072		0.0004				
24510a03	pyrite	1.6186		0.8181					0.0170	0.0055						
24510a04	pyrite	1.6208		0.8160					0.0141	0.0066		0.0004				
24510a05	pyrite	1.6183		0.7266		0.0284	0.0445		0.0052	0.0070		0.0014				
24510a06	pyrite	1.5871		0.7161		0.0257	0.0499		0.0041	0.0092		0.0012				
24510a07	pyrite	1.5899		0.7624		0.0083	0.0349		0.0081	0.0054		0.0009				
24510a08	pyrite	1.5768		0.8011					0.0073	0.0059		0.0004				
24510a09	pyrite	1.5703		0.8162					0.0172	0.0061		0.0003				
24510a10	pyrite	1.6049		0.8145					0.0188	0.0068		0.0005				
24510a11	pyrite	1.6320		0.8222					0.0067	0.0052		0.0003				
24510a12	pyrite	1.5684		0.7735		0.0014	0.0264		0.0117	0.0073		0.0005				
24510a13	pyrite	1.6261		0.7214		0.0327	0.0475		0.0041	0.0052		0.0016				
35001d01	pyrite	1.6311		0.8063					0.0125	0.0053		0.0003				
35001d02	pyrite	1.6398		0.6724	0.0529	0.0579	0.0069			0.0053	0.0004	0.0042				
35001d03	pyrite	1.6411		0.6341	0.0682	0.0705	0.0194			0.0060	0.0006	0.0036				
35001d04	pyrite	1.6283		0.5583	0.1110	0.1155	0.0063			0.0065	0.0001	0.0033				
35001d05	pyrite	1.6239		0.6632	0.0701	0.0681	0.0022			0.0056		0.0025				
35001d06	pyrite	1.6005		0.6715	0.0288	0.0451	0.0151			0.0048	0.0002	0.0041				
35001d07	pyrite	1.6236		0.4498	0.1405	0.1185	0.0771			0.0054	0.0008	0.0028				
35001d08	pyrite	1.6277		0.7008	0.0263	0.0690	0.0082		0.0032	0.0056		0.0015				
35001d09	pyrite	1.6165		0.4555	0.1503	0.1214	0.0740			0.0058	0.0013	0.0038				
35001d10	pyrite	1.6236		0.6430	0.0575	0.0635	0.0203			0.0056		0.0033				
35001d11	pyrite	1.6408		0.6770	0.0535	0.0615	0.0066			0.0058	0.0007	0.0042				
35001d12	pyrite	1.6283		0.5427	0.1164	0.1008	0.0313			0.0058	0.0010	0.0042				
35001d13	pyrite	1.6302		0.8162					0.0117	0.0059		0.0005				
35001d14	pyrite	1.6221		0.8153					0.0120	0.0063		0.0003				
35001d15	pyrite	1.6218		0.8149					0.0141	0.0054		0.0006				
35001d21	chalcopyrite	1.0894		0.5289			0.5327			0.0042		0.0002				
35001d22	chalcopyrite	1.0888		0.5248			0.5334			0.0053		0.0002				
35001d23	tennantite	1.1206		0.0673	0.1632	0.1765	0.4311	0.1216		0.0033		0.0061				
35001d24	"	1.0551		0.1696	0.1152	0.1061	0.4712	0.1166		0.0048		0.0033				
35001d25	"	1.1031		0.0338	0.1763	0.1872	0.4795	0.1095		0.0048		0.0074				
35001d26	"	1.1190		0.1441	0.1018	0.1352	0.4468	0.1935		0.0052		0.0054				
35001d27	"	1.1490		0.0190	0.2214	0.2410	0.4438	0.0350		0.0042		0.0055				
35001d28	chalcopyrite	1.0913		0.5157			0.5371			0.0041		0.0001				

Microprobe Analyses - Orphan Mine Samples - Atomic proportions

Sample #	Mineral	S prop	Mn prop	Fe prop	Co prop	Ni prop	Cu prop	Zn prop	As prop	Mo prop	Ag prop	Pb prop	V prop	Se prop	Cd prop	Sb prop
35001d29	chalcopyrite	1.0903		0.5273			0.5342			0.0041						
35001g01	chalcopyrite✓	1.0884		0.5146			0.5633			0.0042						
35001g02	chalcopyrite✓	1.0991		0.5220			0.5436			0.0045		0.0001				
35001g03		1.0647		0.0242	0.1488	0.2156	0.6070	0.0509		0.0041		0.0192				
35001g04		0.9896		0.0501	0.0606	0.0940	0.8407	0.0359		0.0032		0.0109				
35001g05	covellite?	0.9755		0.0421	0.0407	0.0692	0.9101	0.0272		0.0032		0.0096				
35001g06	chalcopyrite✓	1.0997		0.5121			0.5450	0.0034		0.0054		0.0003				
35001g07		1.0442		0.2374	0.0171	0.0150	0.4171	0.3710		0.0043		0.0032				
35001g08		1.0226		0.0258	0.0906	0.1444	0.6914	0.1075		0.0040		0.0229				
35001g09		0.9191		0.0240	0.0689	0.0894	0.5958	0.0802		0.0032		0.0581				
35001g10	covellite?	0.9263		0.0322	0.0127	0.0157	0.9274	0.0564		0.0047		0.0199				
35001g11	"	0.9809		0.0913	0.0248	0.0342	0.8248	0.0673		0.0035		0.0097				
35001g12		1.0516		0.0143	0.0316	0.0305	0.1574	0.7389		0.0039		0.0080				
35001g13		1.0803		0.0124	0.1156	0.1080	0.3008	0.4089		0.0035		0.0093				
35001g14		1.0230		0.0451	0.0843	0.0853	0.4410	0.3365		0.0039		0.0106				
35001c01	pyrite	1.6511		0.8088						0.0070						
35001c02	covellite?	0.9562		0.0063	0.0105	0.0066	1.0184			0.0075	0.0006	0.0047				
35001c03	"	0.9409		0.0030	0.0141	0.0111	1.0009	0.0090		0.0053	0.0007	0.0046				
35001c04	"	1.0819		0.0045	0.0477	0.0768	0.8434	0.0352		0.0041	0.0001	0.0049				
35001c05	"	1.0700		0.0039	0.0334	0.0554	0.8749	0.0976		0.0050	0.0003	0.0028				
35001c06	"	1.0139		0.0043	0.0064	0.0031	0.9846			0.0067	0.0005	0.0048				
35001c07	"	0.9684		0.0086	0.0154	0.0102	0.8513	0.1426		0.0060		0.0050				
35001c08	"	1.0626		0.0027	0.0255	0.0347	0.8683	0.0799	0.0035	0.0040	0.0006	0.0034				
35001c09	cov/enargite?	1.0432		0.0027	0.0098	0.0077	0.7660	0.0171	0.1806	0.0041		0.0039				
35001c10	covellite	1.0520		0.0036		0.0014	1.0161			0.0049		0.0018				
35001c11	"	1.0276		0.0016	0.0244	0.0250	0.8994	0.0211	0.0045	0.0044	0.0006	0.0022				
35001c12	covellite	1.0669		0.0018		0.0020	0.9808			0.0036		0.0006				
35001c13	covellite?	1.0382		0.0020	0.0153	0.0160	0.9171	0.0223	0.0009	0.0040	0.0006	0.0029				
35001c14	"	1.0289		0.0036	0.0215	0.0261	0.9034	0.0188	0.0128	0.0040	0.0006	0.0082				
35001c15	enargite✓	1.0311		0.0068			0.7803		0.2321	0.0051						
35001c21	enargite	1.0177		0.0172			0.7712		0.2245	0.0053		0.0007				
35001c22		1.0064		0.0018	0.0467	0.0642	0.7318	0.1536		0.0028	0.0014	0.0045				
35001c23		1.0139		0.0027	0.0584	0.0760	0.6536	0.1908		0.0039	0.0006	0.0070				
35001c24	covellite	0.9896		0.0011	0.0244	0.0221	0.8703	0.0194	0.0017	0.0049	0.0003	0.0023				
35001c25	enargite✓	1.0136		0.0131	0.0008		0.7753		0.2244	0.0046		0.0003				

*A Cu-Zn sulfide with these proportions
not in mercat*

Cu₉S₁

Microprobe Analyses - Orphan Mine Samples - Atomic proportions

Sample #	Mineral	S prop	Mn prop	Fe prop	Co prop	Ni prop	Cu prop	Zn prop	As prop	Mo prop	Ag prop	Pb prop	V prop	Se prop	Cd prop	Sb prop
35001c26		0.8717		0.0043	0.0686	0.0727	0.6648	0.1108	0.0012	0.0040	0.0007	0.0040				
{ 35001e01	leucoxene			0.0025									0.0080			
{ 35001e02	leucoxene			0.0018									0.0077			} leuco
35001b01	pyrite	1.5167		0.5010	0.0602	0.0605	0.1827			0.0061	0.0013	0.0063				
35001b02	villimaninit	1.4406		0.2500	0.0591	0.1950	0.3165			0.0059	0.0057	0.0098				
35001b03	villimaninit	1.4992		0.1597	0.0933	0.2024	0.3420			0.0075	0.0057	0.0049				
35001b04	pyrite	1.5541		0.4614	0.0350	0.1049	0.1481			0.0061	0.0019	0.0022				
35001b05	villimaninit	1.4936		0.1599	0.0733	0.1904	0.3555			0.0065	0.0068	0.0074				
35001b06	pyrite	1.5634		0.4702	0.0416	0.1337	0.1547			0.0063	0.0022	0.0048				
35001b07	pyrite	1.6087		0.7728			0.0028			0.0060		0.0052				
35001b08	pyrite	1.6168		0.7044	0.0124	0.0083	0.0581			0.0073	0.0001	0.0080				
X 35001b09	X	1.5768		0.4127	0.0499	0.0947	0.1388			0.0063	0.0026	0.0050				
35001b10	pyrite	1.5494		0.7354			0.0162			0.0064		0.0106				
1150gd02	rammelsbergi	0.0373		0.0022	0.0480	0.4401	0.0171		0.9119							
1150gd03	rammelsbergi	0.0057		0.0001	0.0409	0.4521	0.0050	0.0023	0.9399							
1150gd01	rammelsbergi	0.0007		0.0070	0.4880	0.0031	0.0031		0.9472	0.0002			0.0001			
1150gd05		0.7654		0.0872	0.0010	0.0083	1.0246	0.0038	0.0003	0.0037						
1150gd06		0.7931		0.1499	0.0002	0.0058	0.9436		0.0002	0.0025	0.0003		0.0005			
1150gd08		0.7755		0.0375	0.0014	0.0140	0.6857	0.2369	0.0199	0.0030			0.0005			
X 1150gd07	X	0.0026		0.0183	0.0012	0.0179	0.0398	0.0107	0.0831	0.0016			0.0025			
1150gx01	rammelsbergi	0.0019		0.0007	0.0144	0.4759	0.0025		0.9503		0.0007		0.0002			
1150gx02		0.8599		0.0978		0.0066	0.5626	0.3501	0.0013	0.0033						
1150gx03	rammelsbergi	0.0002		0.0001	0.0245	0.4663	0.0022		0.9433		0.0002					
1150gx04		0.7258		0.0357	0.0013	0.0025	1.1080	0.0106	0.0002	0.0021	0.0002					
1150gx05	chalcopyrite	1.0495		0.5262	0.0007	0.0001	0.5099		0.0002	0.0038			0.0001			
1150gx06	chalcopyrite	1.0454		0.5178	0.0018		0.5129	0.0014		0.0046						
1150gx07	covellite	0.9506		0.0004		0.0003	1.0429			0.0035	0.0009		0.0002			
1150gx08	pyrite	1.6294		0.7944	0.0014	0.0004	0.0175		0.0005	0.0054						
1150gx09	chalcopyrite	1.0341		0.5208	0.0020		0.5177			0.0043						
1150gx10	pyrite	1.6169		0.7861	0.0027		0.0160		0.0003	0.0061						
1150gx11	chalcopyrite	1.0352		0.5226	0.0007		0.5169		0.0002	0.0045	0.0002		0.0001			
1150gx12	chalcopyrite	1.0540		0.5197	0.0005		0.5137		0.0004	0.0035			0.0004			
35001b3a	villimaninit	1.4606		0.0794	0.0790	0.1746	0.3856			0.0056	0.0091					
35001b3b	villimaninit	1.4617		0.0804	0.0781	0.1692	0.3864		0.0002	0.0049	0.0079		0.0002			

(Cu_{.39} Fe_{.08} Co_{.08} Ni_{.17}) S_{1.46}

Microprobe Analyses - Orphan Mine Samples - Atomic proportions

Sample #	Mineral	S prop	Mn prop	Fe prop	Co prop	Ni prop	Cu prop	Zn prop	As prop	Mo prop	Ag prop	Pb prop	V prop	Se prop	Cd prop	Sb prop
35001b3c	villimaninit	1.3865		0.2600	0.0426	0.1446	0.2620		0.0005	0.0053	0.0061					
3501b3d	villimaninit	1.4018		0.0885	0.0715	0.1645	0.3534		0.0001	0.0058	0.0086					
35001x01	pyrite	1.5804		0.6896	0.0113	0.0115	0.0268			0.0058	0.0016			0.0003		
35001x02	chalcopyrite	1.0521		0.5333	0.0008	0.0002	0.5193	0.0016		0.0038	0.0004			0.0003		
35001x03	villiman.	1.3089		0.2450	0.0367	0.1213	0.3069		0.0014	0.0051	0.0055					
35001b11	X	1.3205	metals low	0.2348	0.0438	0.1463	0.1928		0.0006	0.0050	0.0045			0.0004		
1150gb02	rammelsbergi	0.0084			0.0051	0.4698			0.9132							
1150gb03	rammelsbergi	0.1107			0.0119	0.4214	0.0730	0.0017	0.8255			0.0024				
1150gb04	rammelsbergi	0.1435			0.0104	0.3948	0.1009	0.0018	0.8078			0.0039				
1150gxs1	chalcopyrite	1.0382		0.5592			0.5353			0.0047		0.0001				
1150gxs2	?	0.7161		0.0643			1.1377			0.0022		0.0001				
1150xgs3	?	0.5623		0.0109	0.0058	0.0174	0.8075	0.0032	0.1534	0.0018		0.0008				
1150gxs4	nickeline	0.0097			0.0037	0.7241			0.7062							
1150gxs5	chalcopyrite	1.0676		0.5510			0.5441			0.0042		0.0003				
1150gxs	Covellite	0.9210				0.0061	0.9899			0.0035		0.0003				
1150gxs6	native silve					0.0003					0.8886					
1150gxs7	native silve						0.0011				0.8465					
1150gxs8	silver						0.0806	0.0141			0.7751	0.0011				
1150gxs9	silver	0.0003				0.0027	0.1045	0.0945			0.6592	0.0022				
1150xs10	silver					0.0005					0.8359					
1150xs11	rammelsbergi				0.0137	0.4461			0.9150		0.0020					
1150xs12	nickeline	0.0162			0.0012	0.7617	0.0006		0.7091							
1150xs13	silver						0.0076				0.8266					
1150xs14		0.6952		0.0269		0.0010	1.1399			0.0026						
1150xs14b		0.7027		0.0193		0.0022	1.1560			0.0028						
1150xs16		0.7229		0.0070		0.0056	1.1476			0.0027						
1150xs17		0.8757				0.0031	1.0057		0.0007	0.0038						
1150gz01	rammelsbergi	0.0359			0.0044	0.4756	0.0264		0.8808							
1150gz03	rammelsbergi	0.0243			0.0008	0.4757	0.0209		0.8812							
1150gy01	rammelsbergi	0.0012				0.4865			0.9073							
1150gw01	nickeline	0.0062			0.0019	0.7356			0.6636							
1150gv01	Covellite	1.0660		0.0048			1.0000			0.0035		0.0002				
1150gu01	"	1.0651		0.0041			0.9940			0.0033						
1150gx13	?gersdorffit	0.5495		0.0038	0.0353	0.5135	0.0178		0.5890	0.0005	0.0004	0.0008				
1150gx14	rammelsbergi	0.0430			0.0260	0.4626			0.8905							
1150gx15	rammelsbergi	0.0003			0.0339	0.4601			0.9183							

(Cu_{2.22}Fe_{2.26}Ni_{1.15}Co_{0.04}Ag_{0.01})₇₂ S_{1.39}

Cu_{1.14} S_{1.7}

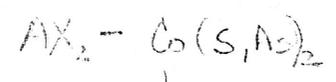
Microprobe Analyses - Orphan Mine Samples - Atomic proportions

Sample #	Mineral	S prop	Mn prop	Fe prop	Co prop	Ni prop	Cu prop	Zn prop	As prop	Mo prop	Ag prop	Pb prop	V prop	Se prop	Cd prop	Sb prop
1150gx16	rannelsbergi				0.0044	0.4815			0.9150							
1150gx17		0.7317		0.0614		0.0007	1.0949			0.0017						
35001a01	Pyrite	1.4898		0.3690	0.1412	0.1145	0.1111		0.0099	0.0050	0.0027	0.0024				
35001a02	As-Cu-bearing	1.5173		0.7560	0.0168	0.0112	0.0258		0.0327	0.0059		0.0009				
35001a03	Cu-Ni-Co-As-	1.5104		0.4228	0.0962	0.1122	0.1435		0.0383	0.0058	0.0023	0.0029				
35001a04	Cu-Ni-Co-bea	1.5584		0.6136	0.0467	0.0594	0.0702			0.0052	0.0007	0.0053				
35001a05	Cu-Ni-Co-As-	1.5126		0.4308	0.0955	0.1005	0.1316		0.0240	0.0056	0.0016	0.0037				
35001a06	Ni-As-Co-Cu-	1.3807		0.3440	0.1200	0.1313	0.1114		0.1010	0.0041	0.0029	0.0032				
35001a07	pyrite	1.6542		0.7802	0.0049	0.0143	0.0019			0.0055		0.0038				
35001a08	Ni-bearing-p	1.6579		0.7680	0.0051	0.0177	0.0027			0.0046		0.0041				
35001a09	pyrite	1.6476		0.8017		0.0031				0.0047		0.0031				
35001a10	pyrite	1.5977		0.7789	0.0024	0.0032	0.0024			0.0044		0.0034				
35001a11	Ni-Cu-bearing	1.6171		0.7410	0.0081	0.0363	0.0161			0.0052		0.0047				
35001a12	Ni-Cu-bearing	1.5968		0.7619	0.0064	0.0218	0.0157			0.0052		0.0039				
35001a13	As-Co-Ni-bea	1.4359		0.6869	0.0256	0.0250	0.0087		0.0641	0.0045		0.0019				
35001a14	pyrite	1.6495		0.7947	0.0007	0.0022				0.0055		0.0045				
35001a15	As-Co-Ni-Cu-	1.4116		0.5932	0.0587	0.0535	0.0337		0.1002	0.0054	0.0001	0.0018				
35001x04	pyrite	1.6504		0.8101					0.0140	0.0055		0.0006				
35001x05	pyrite	1.6146		0.7986			0.0017		0.0283	0.0063		0.0014				
58503b01	As-bearing-py	1.6096		0.7846					0.0214	0.0064		0.0001				
58503b02	pyrite	1.6087		0.7974					0.0111	0.0066		0.0001				
58503b03	As-bearing-p	1.5797		0.7818					0.0235	0.0047		0.0002				
58503b04	As-bearing-p	1.5750		0.7880					0.0262	0.0059		0.0002				
58503b21	Ni-bearing-c	0.6269		0.0081	0.3662	0.2313			0.5508	0.0015						
58503b22	Ni-bearing c	0.6930		0.0244	0.3032	0.2797	0.0216		0.5127	0.0025		0.0005				
58503b23	Ni-bearing c	0.6231		0.0174	0.3397	0.2240	0.0148		0.5021	0.0015		0.0003				
58503b24	Ni-bearing c	0.6328		0.0081	0.3287	0.2471			0.5364	0.0009						
58503b25	Ni-bearing-c	0.6649		0.0111	0.3273	0.2695	0.0061		0.5356	0.0015		0.0001				
58503b26	Cu-As-Co-bea	1.5818		0.7241	0.0187	0.0077	0.0474		0.0275	0.0067		0.0006				
58503b27	As-Cu-bearing	1.5853		0.7628	0.0042	0.0032	0.0214		0.0235	0.0071		0.0002				
58503b29	Ni-bearing-c	0.6422		0.0136	0.3154	0.2669	0.0090		0.5344	0.0007		0.0001				
58503b210	Ni-bearing c	0.6440		0.0138	0.3037	0.2851	0.0135		0.5435	0.0020						
58503b212	Ni-bearing-c	0.6465		0.0106	0.3277	0.2686	0.0116		0.5430	0.0022						
58503b213	Ni-bearing-c	0.6393		0.0066	0.3319	0.2672			0.5514	0.0017						
58503b214	Ni-bearing c	0.6515		0.0048	0.3309	0.2717			0.5467	0.0016						
58503b215	Ni-bearing c	0.6500		0.0118	0.3124	0.2700	0.0148		0.5285	0.0022		0.0005				

$(\text{Fe}_{.37} \text{Co}_{.14} \text{Ni}_{.11} \text{Cu}_{.11})_{.73} (\text{S}_{1.49} \text{As}_{.01})_{1.5}$

$(\text{Co}_{.37} \text{Ni}_{.23})_{.6} \text{As}_{.55} \text{S}_{.63}$

90% =
gersdorffite



Microprobe Analyses - Orphan Mine Samples - Atomic proportions

Sample #	Mineral	S prop	Mn prop	Fe prop	Co prop	Ni prop	Cu prop	Zn prop	As prop	Mo prop	Ag prop	Pb prop	V prop	Se prop	Cd prop	Sb prop
58503b216	Ni-bearing-c	0.6493		0.0061	0.3182	0.2833	0.0050		0.5474	0.0016		0.0002				
58503b217	Ni-bearing-c	0.6478		0.0045	0.2934	0.3032			0.5514	0.0006		0.0003				
58503b218	Ni-bearing-c	0.6599		0.0124	0.3266	0.2577	0.0124		0.5253	0.0021		0.0006				
58503b219	Ni-Cu-bearing	0.6693		0.0367	0.3066	0.2609	0.0280		0.5111	0.0013		0.0044				
58503b31	Fe-Ni-Cu-bea	0.9238		0.2068	0.2413	0.1952	0.0307		0.3743	0.0035		0.0012				
58503b32	Cu-Ni-bearing	0.7027		0.0077	0.2818	0.2068	0.2762		0.4562	0.0023						
58503b33	Ni-bearing-c	0.6038		0.0141	0.3275	0.2456	0.0016		0.5327	0.0024		0.0008				
58503b05	As-bearing p	1.5354		0.7839					0.0242	0.0045		0.0003				
58503b06	As-bearing p	1.5279		0.7888					0.0263	0.0047		0.0005				
58503c01	As-bearing p	1.6174		0.7991					0.0259	0.0059		0.0003				
58503c02	As-bearing p	1.6096		0.7984					0.0254	0.0053		0.0004				
58503c03	pyrite	1.6430		0.8092					0.0016	0.0057						
58503c04	As-bearing p	1.5850		0.7934					0.0252	0.0056		0.0003				
58503c05	marcasite	1.6214		0.8043					0.0057	0.0060		0.0002				
58503c06	marcasite	1.5993		0.8088					0.0117	0.0052		0.0002				
58503c07	As-bearing p	1.5865		0.8006					0.0260	0.0055		0.0003				
58503c08	As-bearing p	1.6024		0.7970					0.0280	0.0052		0.0001				
58503c09	As-bearing p	1.6149		0.8004					0.0242	0.0054		0.0002				
58503a01	As-bearing m	1.6196		0.8000					0.0246	0.0056		0.0002				
58503a02	As-bearing m	1.6386		0.8015					0.0162	0.0049		0.0004				
58503a03	As bearing p	1.6177		0.7990					0.0264	0.0060		0.0005				
58503a04	pyrite	1.6349		0.8099					0.0077	0.0053						
58503a15	As-bearing p	1.6037		0.7940					0.0252	0.0053		0.0002				
58503a16	pyrite	1.6455		0.8129					0.0036	0.0052		0.0001				
58503d01	energite?	0.8913		0.0392	0.0064	0.0007	0.6556	0.0962	0.2192	0.0023		0.0001				
58503d02		0.8957		0.0534	0.0081	0.0015	0.6838	0.0877	0.2553	0.0028						
58503d03		0.8536		0.0415	0.0311	0.0112	0.6424	0.0884	0.2810	0.0029		0.0003				
58503d04	pyrite	1.6676		0.8095					0.0048	0.0052		0.0003				
58503b20	Ni-bearing c	0.6393		0.0048	0.3506	0.2417			0.5442	0.0015		0.0002				
58503b21	Ni-bearing c	0.6387		0.0181	0.3197	0.2495	0.0065		0.5197	0.0020		0.0002				
58503x01	As-bearing p	1.6074		0.7914	0.0007				0.0304	0.0051		0.0003				
58534x01		0.7575		0.0204			1.0227			0.0026	0.0042					
58534x02	As-bearing p	1.5971		0.7931					0.0360	0.0053						
58534x03	As-bearing p	1.5956		0.7898					0.0366	0.0054						
58534x05		0.7142		0.0109	0.0025		1.1996			0.0024	0.0001					
9910'x01	galena	0.4307								0.0005		0.4227				

$(Co_{.24} Fe_{.21} Ni_{.20} Cu_{.03,68}) (As_{.37} S_{.92})_{1.29}$

Microprobe Analyses - Orphan Mine Samples - Atomic proportions

Sample #	Mineral	S prop	Mn prop	Fe prop	Co prop	Ni prop	Cu prop	Zn prop	As prop	Mo prop	Ag prop	Pb prop	V prop	Se prop	Cd prop	Sb prop
9910'x02	galena ✓	0.4338														
9910'x03	galena ✓	0.4335								0.0009		0.4153				
9910'x04	sphalerite ✓	1.0513										0.4108				
9910'x05	pyrite ✓	1.6529		0.8063				0.9823		0.0046		0.0005				
9910'x06	uraninite	0.0156		0.0088		0.0048			0.0020	0.0051		0.0011				
9910'x07	pyrite ✓	1.6511		0.7852		0.0046			0.0231			0.0306				
9910'x08	As-bearing p	1.6012	pyrite	0.7900					0.0029	0.0058		0.0026				
9910'x10	Fe-bearing g	0.6528	gersdorffite	0.0424	0.0115	0.5633			0.0330	0.0065		0.0002				
9910'x11	Fe-bearing g	0.7426		0.0827	0.0061	0.5353			0.5020	0.0020		0.0001				
9910'x12	Fe-bearing g	0.7660		0.0745	0.0321	0.5163			0.4941	0.0014						
9910'x13	As-bearing p	1.6130	pyrite	0.7968		0.0019			0.4709	0.0018		0.0007				
9910'x14	Co-Fe-bearing	0.5957	gersdorffite	0.0319	0.0921	0.4546	0.0028		0.0195	0.0047		0.0005				
9910'x15	Co-Fe-bearing	0.6025	"	0.0265	0.0611	0.5040			0.4577	0.0009		0.0036				
9910'x16	Co-Fe-bearing	0.5748	"	0.0179	0.0794	0.4141	0.0052		0.5025	0.0014		0.0007				
9910'x17	Fe-bearing g	0.6344	"	0.0412	0.0132	0.5582			0.4753	0.0019		0.0058				
9910'x18	Fe-Co-bearing	0.6431	gersdorffite	0.0403	0.0258	0.5459			0.5516	0.0010						
9910'x19	vaesite?	1.5931		0.2043	0.1361	0.4503	0.0005		0.5439	0.0019		0.0026				
9910'x20	bornite?	1.5344		0.3723	0.1663	0.1160	0.0703		0.0071	0.0057		0.0089				
9910'x21	vaesite?	1.5672		0.2745	0.1699	0.2862	0.0343		0.0091	0.0046	0.0089	0.0180				
9910'x22	pyrite	1.6520		0.7803		0.0017	0.0049		0.0044	0.0049	0.0050	0.0143				
9910'x23	vaesite?	1.6124		0.1701	0.1376	0.4773	0.0035		0.0023	0.0064		0.0006				
9910'x25	pyrite	1.6464		0.7836	0.0007	0.0046			0.0001	0.0057		0.0009				
9910'x26	vaesite?	1.6264		0.1980	0.2031	0.3940	0.0052		0.0004	0.0064		0.0008				
9910'x27	pyrite	1.6433		0.8000		0.0022			0.0028	0.0057		0.0013				
9910'x28	vaesite?	1.6214		0.1982	0.1566	0.4440	0.0022			0.0054		0.0007				
9910'x29	vaesite?	1.5609		0.3409	0.2233	0.1501	0.0559		0.0009	0.0052		0.0009				
9910'x30	bravoite	1.6305		0.2222	0.0943	0.4759	0.0011		0.0071	0.0050	0.0075	0.0175				
9910'x31	vaesite?	1.5457		0.3246	0.2060	0.1303	0.0689			0.0068		0.0007				
s1b11x01	bornite-mass	0.6556					1.2556									
s1b11x02	bornite-mass	0.6503					1.2680									
s1b11x03	bornite-mass	0.6612					1.2539									
s1b11x04	Cu sulf -rnd	0.6790					1.2852									
s1b11x05	Cu sulf -rnd	0.6758					1.3088									
s1b11a01	Cu sulf -rnd	0.6540					1.1939									
s1b11a02	Cu sulf -rnd	0.6640					1.2740									
s1b11a03	Cu sulf -rnd	0.6615					1.2463									
s1b11a04	Cu sulf -rnd	0.6618					1.2548									

$Ni_{.58}As_{.54}S_{.64}$
 $(Ni_{.45}Fe_{.20}Co_{.14})_{.11}S_{1.59}$
 $(Ni_{.37}Co_{.17}Ni_{.12})_{.81}S_{1.53}$
 $(Ni_{.24}Co_{.17}Fe_{.27})_{.73}S_{1.57}$
 $(Ni;Fe(Co))_{.99}S_2$
 $(Fe,Co)(Ni)_{1.5}S_2$
 $(Ni;Fe,Co)_{.93}S_2$
 $(Ni_{.48}Fe_{.22})_{.79}S_{1.6}$
 $(Ni_{.40}Fe_{.22}Co_{.04})_{.79}S_{1.6}$
 $Cu_{1.26}S_{.66}$

Chalcocite?

* vaesite-cationite-pyrite series

Microprobe Analyses - Orphan Mine Samples - Atomic proportions

Sample #	Mineral	S prop	Mn prop	Fe prop	Co prop	Ni prop	Cu prop	Zn prop	As prop	Mo prop	Ag prop	Pb prop	V prop	Se prop	Cd prop	Sb prop
s1b11a05	Cu sulf -rnd	0.6456	chalcocite				1.2726				0.0017					
s1b11x06	chalcocite	0.6446					1.2762				0.0005					
s1b11b01	bladed grns	0.6596	"				1.2452				0.0000					
s1b11c01	Cu min.-lg b	0.6665	"				1.2502				0.0000					
s1b11d01	Cu min w/in	0.6843	"				1.2539				0.0000					
s1b11e01	Cu min w/in	0.6911	"				1.2184				0.0000					
s1b11f01	Cu min w/in	0.6752	"				1.2688				0.0000					
991Gx01	Cu sulf grn	0.7607		0.1221			0.9594									
991Ga01	Cu sulf grn	0.7535		0.1481			0.9558									
991Ga02	Cu sulf grn	0.7282		0.1354			0.9912									
991Gxb01	cerrusite											0.3390				
991Gxc01	Cu-Fe-S	0.8262		0.1950			0.9902									
991Gxc01	Cu-Fe-S	0.8274		0.1903			0.9928									
991Gxd01	Cu-S	0.7011					1.2436									
991Gxe01	Pb-cerrusite											0.3516				
991Gxf01	Cu-Fe-Zn-S g			0.2236		0.0124		0.3912								
991Gxh01	Zn-S	1.0604	sphalerite					0.9792								
991Gxh02	Zn-S	1.0516	Sphalerite				0.0058	0.9858								
991Gxi01	Cu-Fe-S	0.8068	bornite?	0.1900			0.9814									
9910'x32	galena	0.4357										0.4118				
9910'd01	pyrite	1.6642		0.7995		0.0153				0.0079						
9910'd02	pyrite	1.6486		0.7635		0.0247			0.0087	0.0073						
9910'd03	pyrite	1.0389		0.2838		0.1482			0.1696			0.0607				
9910'd04	pyrite	0.7220		0.2795		0.0654			0.0631			0.0149				
9910'e01	pyrite cube core	0.7710		0.1241		0.4914			0.4716			0.0121				
9910'e02	pyrite cube rim	1.6582		0.8040					0.0152	0.0070						
9910'e03	pyrite cube core	0.6537		0.0290		0.5556			0.5502							
9910'e04	pyrite cube rim	1.6632		0.7974					0.0152	0.0066						
9910'e05	pyrite cube core	0.6624		0.0457		0.5728			0.5546							
9910'e06	pyrite cube core	0.8854		0.1538		0.4159			0.4425							
9910'e07	pyrite cube rim	1.5934		0.7689					0.0115	0.0074						
9910'e08	pyrite cube rim	1.6177		0.7968					0.0131	0.0073						
9910'f01	sphalerite	1.0588						0.9725								
9910'f02	As-Pb-S gale	0.4332										0.4141				
9910'g01	Fe-S-As pyrite	1.5884		0.7843					0.0436	0.0061						
9910'h01	pyrite core	0.8761		0.1782		0.4207			0.4064			0.0056				

(Cu_{0.95}Fe_{0.12})S_{1.07}

(Cu_{0.99}Fe_{0.19})S_{1.19}

Cu_{1.2}S_{1.7}

(Fe_{0.28}Ni_{0.14})_{0.42}(S₁As_{0.17})_{1.17}

(Fe_{0.28}Ni_{0.01})_{0.29}(As_{0.06}S_{0.78})_{1.04}

(Ni_{0.49}Fe_{0.12})_{0.63}(S_{0.77}As_{0.47})_{1.24}

(Ni_{0.55}Fe_{0.03})_{0.58}(S_{0.65}As_{0.55})_{1.20}

(Ni_{0.57}Fe_{0.05})_{0.62}(S_{0.66}As_{0.55})_{1.21}

(Ni_{0.42}Fe_{0.15})_{0.57}(As_{0.44}S_{0.89})_{1.32}

(Ni_{0.42}Fe_{0.19})_{0.61}(S_{0.88}As_{0.41})_{1.29}

Microprobe Analyses - Orphan Mine Samples - Atomic proportions

Sample #	Mineral	S prop	Mn prop	Fe prop	Co prop	Ni prop	Cu prop	Zn prop	As prop	Mo prop	Ag prop	Pb prop	V prop	Se prop	Cd prop	Sb prop
9910'h02	pyrite core	0.6649		0.0244					0.5600							
9910'h03	pyrite rim	1.6682		0.8129						0.0074				(Ni _{0.57} Fe _{0.02}) (As _{3.50} S _{6.71}) _{1.33}		barroite?
9911'a01	pyrite vein	1.5899		0.7648					0.0574							
9911'a02	Cu vein asso	0.6961		0.0202			1.2347									
9911'a03	Cu vein asso	0.7176		0.0054			1.2048									
9911'a04	pyrite vein	1.5928		0.7630			0.0140		0.0515					Cu _{1.2} S _{1.72}		
9911'a05	copper vein	0.6886		0.0145			1.2197									
9911'a06	Cu-As-S vein	0.9010	enargite?				0.7180	0.0944	0.2533					Cu _{1.2} As _{0.25} S _{1.9}		Cu _{3.2} As _{1.1} S ₄ enargite?
9911'a07	CuS	0.6849					1.2205									
9911'a08	Cu-As-S	0.8857	enargite?				0.7351	0.0797	0.2464					Cu _{1.74} As _{0.25} S _{1.89}		Cu _{3.3} As _{1.1} S ₄
9911'a09	Cu-As-S	0.9048					0.7166	0.0976	0.2491							
9911'a10	matrix w/ Cu	0.7111	digonite				1.2252							Cu _{1.23} S _{1.71}		Cu ₉ S _{5.2}
9911'a11	Cu-As-S vein	0.9216	enargite				0.7251	0.0971	0.2619					Cu _{1.13} (As _{0.26} S _{0.42}) _{1.18}		Cu _{3.2} As _{1.1} S ₄
9911'a12	pyrite vein	1.6243		0.7709					0.0526							
9911'a13	pyrite vein	1.6339		0.7945					0.0340	0.0063						
9911'a14	Cu-As-S	0.9125	enargite				0.7210	0.0873	0.2527							
400R3b01	galena	0.4093		0.0010			0.0012					0.4139	0.0010		0.0012	0.0002
400R3b02	galena	0.4141		0.0006		0.0017	0.0005	0.0006				0.4217		0.0000	0.0007	
400R3b03	galena	0.4069		0.0018		0.0011	0.0011				0.0002	0.4165	0.0005		0.0003	0.0001
400R3b05	chalcopyrite	1.0690		0.5791	0.0008	0.0000	0.5262	0.0016	0.0001	0.0043			0.0002	0.0002		
400R3b06	chalcopyrite	1.0694		0.5636	0.0012		0.4869	0.0010	0.0009	0.0044						0.0002
400R3b04	galena	0.4095		0.0012		0.0010					0.0007	0.4209				0.0012
400R3b07	pyrite	1.6553		0.8180	0.0016	0.0005	0.0014	0.0003	0.0008	0.0062	0.0001	0.0003	0.0003			0.0002
400R3b08	pyrite	1.6398		0.8364	0.0014				0.0004	0.0060	0.0013	0.0000		0.0002		0.0002
400R3b09	pyrite chole	1.0788		0.5677	0.0017		0.5020	0.0008	0.0007	0.0046	0.0004	0.0003		0.0001		0.0004
400R3b10	pyrite	1.6645		0.8239	0.0011		0.0017		0.0015	0.0062						
400R3b11	pyrite	1.6794		0.8426	0.0013				0.0003	0.0059						
400R3x01	pyrite	1.6153		0.8367	0.0014		0.0008		0.0002	0.0067	0.0001	0.0012				
400R3x02	galena	0.4171		0.0004			0.0023	0.0006				0.4186			0.0006	
400R3x03	galena (low total)	0.2210		0.0122	0.0002	0.0011	0.0000					0.2804	0.0013		0.0010	oxidized? low total
400R3a01	galena	0.4133									0.0009	0.4145	0.0002	0.0001	0.0004	0.0005
400R3a02	galena	0.4183		0.0005	0.0006		0.0012	0.0004				0.4174		0.0006	0.0007	0.0002
400R3a03	pyrite	1.6651		0.8329	0.0015		0.0050	0.0013	0.0004	0.0072		0.0002	0.0003			
400R3a04	pyrite	1.6476		0.8298	0.0015	0.0005	0.0017	0.0012	0.0004	0.0063			0.0008	0.0002	0.0002	
400R3a05	pyrite	1.5993		0.8171	0.0013	0.0001	0.0040	0.0006	0.0014	0.0050	0.0005	0.0036	0.0008	0.0001		
400R3x04	pyrite	1.6445		0.8409	0.0016		0.0030	0.0008	0.0005	0.0065	0.0009		0.0009	0.0000		

Microprobe Analyses - Orphan Mine Samples - Atomic proportions

Sample #	Mineral	S prop	Mn prop	Fe prop	Co prop	Ni prop	Cu prop	Zn prop	As prop	Mo prop	Ag prop	Pb prop	V prop	Se prop	Cd prop	Sb prop
400R3x05	pyrite ✓	1.6660 0.0000		0.8363	0.0007		0.0007	0.0052	0.0011	0.0062		0.0003	0.0010	0.0007	0.0001	
991Gx72	chalcopyrite	1.0453		0.5433	0.0011		0.5346	0.0033	0.0001	0.0038	0.0002		0.0004			
*991Ix72	uraninite	0.0015		0.0058	0.0005	0.0001	0.0325	0.0172	0.0178	0.0004		0.0005	0.0027			
991Gx71	digenite	0.6845 0.0000		0.0162	0.0000	0.0003	1.1749			0.0038		0.0002				
03208b01	Cu-S	0.6802	<i>digende?</i>				1.2866			0.0029						
03208b02	Cu-S	0.6721	<i>digenite?</i>				1.2688			0.0029						
03208b03	Cu-S	0.6565	"				1.2710			0.0030						
03208b04	Cu-S	0.6565	"				1.2729			0.0027	0.0017					
03208b05	Cu-S	0.6577	"				1.2753			0.0030	0.0022					
03208x06	dig/chalco ma	0.6587	"				1.2756			0.0032	0.0019					
03208x07	dig/chalco ma	0.6755					1.2458			0.0035						
02652a01	marcasite ✓	1.6704		0.8179						0.0076						
02652a02	pyrite worm ✓	1.6589		0.8208						0.0077						
02652a03	pyrite ✓	1.6405		0.8199					0.0055	0.0089		0.0003				
02652a04	pyrite ✓	1.6314		0.8214						0.0084		0.0002				
02652a05	marcasite ✓	1.6445		0.8256						0.0079		0.0008				
02652a06	marcasite ✓	1.6695		0.8305					0.0005	0.0074		0.0005				
02652a07	marcasite ✓	1.6514		0.8188						0.0074		0.0002				
02652a08	pyrite worm ✓	1.6754		0.8330						0.0092		0.0002				
02652x01	pyrite, frac ✓	1.6664		0.8375					0.0011	0.0076		0.0005				
02652x02	pyrite, frac ✓	1.6498		0.8265					0.0024	0.0079		0.0005				
02652x03	Ni-cube w/in ✓	1.6027		0.6691	0.0224	0.0785	0.0411			0.0080		0.0016				
02652x04	Ni-cube w/in ✓	1.5675		0.3510	0.1442	0.3170	0.0121		0.0027	0.0069		0.0008				
02652x05	Ni-cube w/in ✓	1.5531		0.4194	0.1366	0.2446	0.0138			0.0083		0.0005				
02652x06	pyrite aroun ✓	1.5753		0.8292					0.0036	0.0084		0.0002				
02652x07	Ni-cube w/in ✓	1.5572		0.7291	0.0187	0.0414	0.0168		0.0155	0.0074		0.0011				
02652x08	Ni-cube w/in ✓	1.5884		0.7925			0.0079		0.0211	0.0076		0.0005				
02652x09	pyrite ✓	1.6252		0.8256						0.0070		0.0003				
02652x10	Ni-cube w/in ✓	1.5952 0.0000		0.4785	0.0938	0.2325	0.0096		0.0111	0.0083		0.0008				
02455a01	Cu-S ?	0.8683		0.0240			0.7309	0.0181	0.2567	0.0024						
02455a02	Cu-S ?	0.8726		0.0236			0.7153	0.0197	0.2584	0.0035						
02455a03	Cu-S ?	0.8823		0.0242			0.6931	0.0190	0.2569	0.0030						
02455a04	Cu-S ?	0.8854		0.0252			0.6867	0.0151	0.2555	0.0031						
02455a05	Cu-S ?	0.8867		0.0256			0.7024	0.0184	0.2515	0.0033						
02455a06	Cu-S ?	0.8726		0.0245			0.6846	0.0144	0.2521	0.0031		0.0002				

Ni-bearing cube in pyrite

$(Fe_{.67}Co_{.02}Ni_{.08}Cu_{.04})_{.81}S_{1.6}$ mostly pyrite
bravoite?
pyrite
pyrite

Microprobe Analyses - Orphan Mine Samples - Atomic proportions

Sample #	Mineral	S prop	Mn prop	Fe prop	Co prop	Ni prop	Cu prop	Zn prop	As prop	Mo prop	Ag prop	Pb prop	V prop	Se prop	Cd prop	Sb prop
02455a07	Cu-S	0.8608		0.0227			0.6862	0.0197	0.2545	0.0032						
02455a09	digenite?	0.6671					1.0401		0.0044	0.0057						
02455a10	digenite?	0.6655					1.0393		0.0009	0.0052		0.0000		$Cu_{1.08}S_{6.7}$		$Cu_{7.8}S_5$
02455a11	digenite?	0.6680					1.0126		0.0060	0.0054		0.0000		$Cu_{low}S_{6.08}digenite$		
02455a13	Cu-S	0.9035		0.0260			0.7677	0.0151	0.2539	0.0028		0.0000				
02455a14	Cu-S	0.9026		0.0263			0.7661	0.0162	0.2533	0.0033				$(Cu_{7.7}Fe_{0.3})As_{2.5}S_9$		$Cu_{11.6}As_{3.6}S_{13}$
02455a15	Cu-S	0.9079		0.0258			0.7710	0.0165	0.2564	0.0029						
02455a16	Cu-S	0.9085		0.0252			0.7669	0.0190	0.2567	0.0027						
02455a17	Cu-S	0.9063		0.0247			0.7693	0.0199	0.2571	0.0033						
02455a18	Cu-S	0.9019		0.0229			0.7698	0.0190	0.2571	0.0038		0.0001				
02455a19	Cu-S	0.9005		0.0244			0.7679	0.0210	0.2579	0.0027						
02455a21	Cu-S	0.7033	digenite?				1.1851		0.0009	0.0052						$Cu_{8.5}S_5$
02455a22	Cu-S	0.6896	digenite				1.1911		0.0079	0.0050						
02455a23	Cu-S	0.7027					1.1952		0.0019	0.0046						
02455b01	Cu-As-S	0.9016		0.0227			0.7627	0.0213	0.2627	0.0033						
02455b02	Cu-As-S	0.8960		0.0226			0.7575	0.0199	0.2565	0.0030				$(Cu_{7.6}Fe_{0.2})As_{2.6}S_9$		
02455b03	Cu-As-S	0.8954		0.0218			0.7625	0.0207	0.2584	0.0044						
02455b04	Cu-As-S	0.9072		0.0224			0.7690	0.0211	0.2576	0.0029						
02455b06	Cu-S	0.7058					1.1925		0.0017	0.0049						
02455b07	Cu-S	0.7055	digenite				1.1783		0.0069	0.0050	0.0008					
03208a01	pyrite-fract	1.6398		0.7821		0.0010	0.0809			0.0071						
03208a02	pyrite-fract	1.6854		0.7950		0.0027	0.0066			0.0071						
03208a03	pyrite-fract	1.6745		0.8043			0.0076			0.0073						
03208a04	pyrite-fract	1.6676		0.7837		0.0010	0.0356			0.0075						
03208a06	matrix aroun	0.6740	digenite?	0.0073			1.2749			0.0027	0.0010					
03208a07	matrix aroun	0.6761	"	0.0084	0.0003		1.2631			0.0023	0.0005					
03208a08	matrix aroun	0.7600	"	0.0827	0.0027		1.1523		0.0065	0.0034	0.0004					
03208x01	pyrite cube	1.6586		0.7907			0.0055			0.0067						
03208x02	pyrite cube	1.6651		0.7726			0.0050			0.0074						
03208x03	Cu-S vein	0.6708	digenite				1.2441			0.0019	0.0017					
03208x04	Cu-S vein	0.6674	"				1.2767			0.0018	0.0012					
03208x05	Cu-S vein	0.6652	"				1.2816			0.0019	0.0011					
03208c01	skeletal gra	0.6537	"				1.2414			0.0014	0.0019					
03208c02	digenite?	0.6612					1.2241			0.0033						

Microprobe Analyses - Orphan Mine Samples - Weight %

Sample #	Mineral	S	Mn	Fe	Co	Ni	Cu	Zn	As	Mo	Ag	Pb	V	Se	Cd	Sb	Total
24510a01	pyrite	51.83		41.42		1.01	2.43		0.54	0.65		0.14					98.02
24510a02	pyrite	52.15		44.99					1.16	0.69		0.09					99.08
24510a03	pyrite	51.90		45.69					1.27	0.53							99.39
24510a04	pyrite	51.97		45.57					1.06	0.63		0.09					99.32
24510a05	pyrite	51.89		40.58		1.67	2.83		0.39	0.67		0.29					98.32
24510a06	pyrite	50.89		39.99		1.51	3.17		0.31	0.88		0.25					97.00
24510a07	pyrite	50.98		42.58		0.49	2.22		0.61	0.52		0.19					97.59
24510a08	pyrite	50.56		44.74					0.55	0.57		0.08					96.50
24510a09	pyrite	50.35		45.58					1.29	0.59		0.07					97.88
24510a10	pyrite	51.46		45.49					1.41	0.65		0.10					99.11
24510a11	pyrite	52.33		45.92					0.50	0.50		0.06					99.31
24510a12	pyrite	50.29		43.20		0.08	1.68		0.88	0.70		0.11					96.94
24510a13	pyrite	52.14		40.29		1.92	3.02		0.31	0.50		0.33					98.51
35001d01	pyrite	52.30		45.03					0.94	0.51		0.07					98.85
35001d02	pyrite	52.58		37.55	3.12	3.40	0.44			0.51	0.04	0.87					98.51
35001d03	pyrite	52.62		35.41	4.02	4.14	1.23			0.58	0.06	0.74					98.80
35001d04	pyrite	52.21		31.18	6.54	6.78	0.40			0.62	0.01	0.69					98.43
35001d05	pyrite	52.07		37.04	4.13	4.00	0.14			0.54		0.51					98.43
35001d06	pyrite	51.32		37.50	1.70	2.65	0.96			0.46	0.02	0.85					95.46
35001d07	pyrite	52.06		25.12	8.28	6.96	4.90			0.52	0.09	0.59					98.52
35001d08	pyrite	52.19		39.14	1.55	4.05	0.52		0.24	0.54		0.32					98.55
35001d09	pyrite	51.83		25.44	8.86	7.13	4.70			0.56	0.14	0.79					99.45
35001d10	pyrite	52.06		35.91	3.39	3.73	1.29			0.54		0.69					97.61
35001d11	pyrite	52.61		37.81	3.15	3.61	0.42			0.56	0.08	0.88					99.12
35001d12	pyrite	52.21		30.31	6.86	5.92	1.99			0.56	0.11	0.86					98.82
35001d13	pyrite	52.27		45.58					0.88	0.57		0.10					99.40
35001d14	pyrite	52.01		45.53					0.90	0.60		0.07					99.11
35001d15	pyrite	52.00		45.51					1.06	0.52		0.12					99.21
35001d21	chalcopyrite	34.93		29.54			33.85			0.40		0.05					98.77
35001d22	chalcopyrite	34.91		29.31			33.89			0.51		0.04					98.66
35001d23		35.93		3.76	9.62	10.36	27.39	7.95		0.32		1.27					96.60
35001d24		33.83		9.47	6.79	6.23	29.94	7.62		0.46		0.69					95.03
35001d25		35.37		1.89	10.39	10.99	30.47	7.16		0.46		1.54					98.27
35001d26		35.88		8.05	6.00	7.94	28.39	12.65		0.50		1.11					100.52
35001d27		36.84		1.06	13.05	14.15	28.20	2.29		0.40		1.14					97.13
35001d28	chalcopyrite	34.99		28.80			34.13			0.39		0.03					98.34

Microprobe Analyses - Orphan Mine Samples - Weight %

Sample #	Mineral	S	Mn	Fe	Co	Ni	Cu	Zn	As	Mo	Ag	Pb	V	Se	Cd	Sb	Total
35001d29	chalcopyrite	34.96		29.45			33.94			0.39							98.74
35001g01	chalcopyrite	34.90		28.74			35.79			0.40							99.83
35001g02	chalcopyrite	35.24		29.15			34.54			0.43		0.02					99.38
35001g03		34.14		1.35	8.77	12.66	38.57	3.33		0.39		3.98					103.19
35001g04		31.73		2.80	3.57	5.52	53.42	2.35		0.31		2.25					101.95
35001g05		31.28		2.35	2.40	4.06	57.83	1.78		0.31		1.98					101.99
35001g06	chalcopyrite	35.26		28.60			34.63	0.22		0.52		0.07					99.30
35001g07		33.48		13.26	1.01	0.88	26.50	24.25		0.41		0.67					100.46
35001g08		32.79		1.44	5.34	8.48	43.93	7.03		0.38		4.74					104.13
35001g09		29.47		1.34	4.06	5.25	37.86	5.24		0.31		12.03					95.56
35001g10		29.70		1.80	0.75	0.92	58.93	3.69		0.45		4.13					100.37
35001g11		31.45		5.10	1.46	2.01	52.41	4.40		0.34		2.01					99.18
35001g12		33.72		0.80	1.86	1.79	10.00	48.30		0.37		1.66					98.50
35001g13		34.64		0.69	6.81	6.34	19.11	26.73		0.34		1.93					96.59
35001g14		32.80		2.52	4.97	5.01	28.02	22.00		0.37		2.20					97.89
35001c01	pyrite	52.94		45.17	0.02					0.67		0.01					98.81
35001c02		30.66		0.35	0.62	0.39	64.71			0.72	0.07	0.97					98.49
35001c03		30.17		0.17	0.83	0.65	63.60	0.59		0.51	0.08	0.95					97.55
35001c04		34.69		0.25	2.81	4.51	53.59	2.30		0.39	0.01	1.02					99.57
35001c05		34.31		0.22	1.97	3.25	55.59	6.38		0.48	0.03	0.59					102.82
35001c06		32.51		0.24	0.38	0.18	62.56			0.64	0.05	0.99					97.55
35001c07		31.05		0.48	0.91	0.60	54.09	9.32		0.58		1.04					98.07
35001c08		34.07		0.15	1.50	2.04	55.17	5.22	0.26	0.38	0.06	0.70					99.55
35001c09		33.45		0.15	0.58	0.45	48.67	1.12	13.53	0.39		0.80					99.14
35001c10	covellite	33.73		0.20	0.16	0.08	64.56			0.47		0.38					99.58
35001c11		32.95		0.09	1.44	1.47	57.15	1.38	0.34	0.42	0.06	0.45					95.75
35001c12	covellite	34.21		0.10	0.25	0.12	62.32			0.35		0.12					97.47
35001c13	covellite?	33.29		0.11	0.90	0.94	58.27	1.46	0.07	0.38	0.07	0.60					96.09
35001c14		32.99		0.20	1.27	1.53	57.40	1.23	0.96	0.38	0.07	1.69					97.72
35001c15	enargite	33.06		0.38	0.05		49.58		17.39	0.49		0.01					100.96
35001c21	enargite	32.63		0.96	0.07		49.00		16.82	0.51		0.15					100.14
35001c22		32.27		0.10	2.75	3.77	46.50	10.04		0.27	0.15	0.94					96.79
35001c23		32.51		0.15	3.44	4.46	41.53	12.47		0.37	0.06	1.46					96.45
35001c24		31.73		0.06	1.44	1.30	55.30	1.27	0.13	0.47	0.03	0.47					92.20
35001c25	enargite	32.50		0.73	0.05		49.26		16.81	0.44		0.07					99.86

Microprobe Analyses - Orphan Mine Samples - Weight %

Sample #	Mineral	S	Mn	Fe	Co	Ni	Cu	Zn	As	Mo	Ag	Pb	V	Se	Cd	Sb	Total
35001c26		27.95		0.24	4.04	4.27	42.24	7.24	0.09	0.38	0.08	0.82					87.35
35001e01				0.14													0.55
35001e02				0.10									0.41				0.49
35001b01	pyrite	48.63		27.98	3.55	3.55	11.61			0.59	0.14	1.30					97.35
35001b02	villimaninit	46.19		13.96	3.48	11.45	20.11			0.57	0.61	2.04					98.41
35001b03	villimaninit	48.07		8.92	5.50	11.88	21.73			0.72	0.61	1.01					98.44
35001b04	pyrite	49.83		25.77	2.06	6.16	9.41			0.59	0.21	0.46					94.49
35001b05	villimaninit	47.89		8.93	4.32	11.18	22.59			0.62	0.73	1.53					97.79
35001b06	pyrite	50.13		26.26	2.45	7.85	9.83			0.60	0.24	0.99					98.35
35001b07	pyrite	51.58		43.16			0.18			0.58		1.07					96.57
35001b08	pyrite	51.84		39.34	0.73	0.49	3.69			0.70	0.01	1.66					98.46
35001b09		50.56		23.05	2.94	5.56	8.82			0.60	0.28	1.03					92.84
35001b10	pyrite	49.68		41.07			1.03			0.61		2.20					94.59
1150gd02	rammelsbergi	1.20		0.12	2.83	25.84	1.09			68.32							99.39
1150gd03	rammelsbergi	0.18		0.01	2.41	26.54	0.32	0.15		70.42							100.03
1150gd01	rammelsbergi	0.02		0.00	0.41	28.65	0.19			70.97	0.02		0.01				100.27
1150gd05		24.54		4.87	0.06	0.49	65.11	0.25		0.02	0.36		0.00				95.70
1150gd06		25.43		8.37	0.01	0.34	59.96			0.02	0.24	0.03	0.03				94.42
1150gd08		24.87		2.09	0.08	0.82	43.57	15.48		1.49	0.29		0.02				88.72
1150gd07		0.08		1.02	0.07	1.05	2.53	0.70		6.23	0.16		0.13				11.96
1150gx01	rammelsbergi	0.06		0.04	0.85	27.94	0.16			71.20		0.07	0.01				100.32
1150gx02		27.57		5.46	0.00	0.39	35.75	22.89		0.10	0.31						92.47
1150gx03	rammelsbergi	0.01		0.01	1.45	27.38	0.14			70.67		0.02					99.67
1150gx04		23.27		2.00	0.07	0.15	70.40	0.69		0.02	0.20	0.02					96.82
1150gx05	chalcopyrite	33.65		29.38	0.04		32.40			0.01	0.36		0.01				95.86
1150gx06	chalcopyrite	33.52		28.92	0.11		32.59	0.09			0.44						95.67
1150gx07		30.48		0.02		0.02	66.27				0.33	0.09	0.01				97.22
1150gx08	pyrite	52.24		44.37	0.08	0.02	1.11			0.04	0.52						98.39
1150gx09	chalcopyrite	33.16		29.09	0.12		32.90				0.41						95.67
1150gx10	pyrite	51.85		43.90	0.16		1.02			0.02	0.58						97.52
1150gx11	chalcopyrite	33.19		29.19	0.04		32.84			0.02	0.43	0.02	0.01				95.73
1150gx12	chalcopyrite	33.79		29.02	0.03		32.64			0.03	0.33		0.02				95.86
35001b3a	villimaninit	46.83		4.44	4.65	10.25	24.50		0.00	0.54	0.99						92.19
35001b3b	villimaninit	46.87		4.49	4.60	9.93	24.55		0.02	0.47	0.85		0.01				91.79

Microprobe Analyses - Orphan Mine Samples - Weight %

Sample #	Mineral	S	Mn	Fe	Co	Ni	Cu	Zn	As	Mo	Ag	Pb	V	Se	Cd	Sb	Total
35001b3c		44.46		14.52	2.51	8.49	16.65		0.04	0.51	0.66						87.84
3501b3d	villimaninit	44.95		4.94	4.22	9.66	22.46		0.01	0.56	0.93		0.02				87.73
35001x01	pyrite	50.68		38.51	0.67	0.67	1.70			0.56	0.17						92.96
35001x02		33.74		29.78	0.05	0.01	33.00	0.11		0.37	0.05		0.01				97.11
35001x03		41.97		13.68	2.17	7.12	19.50		0.10	0.49	0.59						85.62
35001b11		42.34		13.11	2.58	8.59	12.25		0.04	0.48	0.48		0.02				79.90
1150gb02	rammelsbergi	0.27			0.30	27.58			68.42								96.57
1150gb03	rammelsbergi	3.55			0.70	24.74	4.64	0.11	61.85			0.49					96.08
1150gb04	rammelsbergi	4.60			0.61	23.18	6.41	0.12	60.52			0.80					96.24
1150gxs1	chalcopyrite	33.29		31.23			34.01			0.45		0.03					99.01
1150gxs2	?	22.96		3.59			72.29			0.21		0.02					99.07
1150gxs3	?	18.03		0.61	0.34	1.02	51.31	0.21	11.49	0.17		0.16					83.34
1150gxs4	nickeline	0.31			0.22	42.51			52.91								95.95
1150gxs5	chalcopyrite	34.23		30.77			34.57			0.40		0.06					100.03
1150gxs		29.53				0.36	62.90			0.34		0.07					93.20
1150gxs6	native silver					0.02					95.85						95.87
1150gxs7	native silver						0.07				91.31						91.38
1150gxs8	silver						5.12	0.92			83.61	0.22					89.87
1150gxs9	silver	0.01				0.16	6.64	6.18			71.11	0.46					84.56
1150xs10	silver					0.03					90.17						90.20
1150xs11	rammelsbergite				0.81	26.19			68.55		0.22						95.77
1150xs12	nickeline	0.52			0.07	44.72	0.04		53.13								98.48
1150xs13	silver						0.48				89.17						89.65
1150xs14		22.29		1.50		0.06	72.43			0.25							96.53
1150xs14b		22.53		1.08		0.13	73.45			0.27							97.46
1150xs16		23.18		0.39		0.33	72.92			0.26							97.08
1150xs17		28.08				0.18	63.90		0.05	0.36							92.57
1150gz01	rammelsbergi	1.15			0.26	27.92	1.68		65.99								97.00
1150gz03	rammelsbergi	0.78			0.05	27.93	1.33		66.02								96.11
1150gy01	rammelsbergi	0.04				28.56			67.98								96.58
1150gw01	nickeline	0.20			0.11	43.19			49.72								93.22
1150gv01		34.18		0.27			63.54			0.34		0.04					98.37
1150gu01		34.15		0.23			63.16			0.32		0.01					97.87
1150gx13	?gersdorffit	17.62		0.21	2.08	30.15	1.13		44.13	0.05	0.04	0.16					95.57
1150gx14	rammelsbergi	1.38			1.53	27.16			66.72								96.79
1150gx15	rammelsbergi	0.01			2.00	27.01			68.80								97.82

Microprobe Analyses - Orphan Mine Samples - Weight %

Sample #	Mineral	S	Mn	Fe	Co	Ni	Cu	Zn	As	Mo	Ag	Pb	V	Se	Cd	Sb	Total
1150gx16	rammelsbergite				0.26	28.27			68.55								
1150gx17		23.46		3.43		0.04	69.57			0.16							97.08
35001a01		47.77		20.61	8.32	6.72	7.06										96.66
35001a02	As-Cu-bearin	48.65		42.22	0.99	0.66	1.64		0.74	0.48	0.29	0.49					92.48
35001a03	Cu-Ni-Co-As-	48.43		23.61	5.67	6.59	9.12		2.45	0.57		0.19					97.37
35001a04	Cu-Ni-Co-bea	49.97		34.27	2.75	3.49	4.46		2.87	0.56	0.25	0.60					97.70
35001a05	Cu-Ni-Co-As-	48.50		24.06	5.63	5.90	8.36			0.50	0.08	1.10					96.62
35001a06	Ni-As-Co-Cu-	44.27		19.21	7.07	7.71	7.08		1.80	0.54	0.17	0.77					95.73
35001a07	pyrite	53.04		43.57	0.29	0.84	0.12		7.57	0.39	0.31	0.66					94.27
35001a08	Ni-bearing p	53.16		42.89	0.30	1.04	0.17			0.53		0.78					99.17
35001a09	pyrite	52.83		44.77		0.18				0.44		0.84					98.84
35001a10	pyrite	51.23		43.50	0.14	0.19	0.15			0.45		0.64					98.87
35001a11	Ni-Cu-bearin	51.85		41.38	0.48	2.13	1.02			0.42		0.70					96.33
35001a12	Ni-Cu-bearin	51.20		42.55	0.38	1.28	1.00			0.50		0.97					98.33
35001a13	As-Co-Ni-bea	46.04		38.36	1.51	1.47	0.55			0.50		0.81					97.72
35001a14	pyrite	52.89		44.38	0.04	0.13			4.80	0.43		0.39					93.55
35001a15	As-Co-Ni-Cu-	45.26		33.13	3.46	3.14	2.14			0.53		0.94					98.91
35001x04	pyrite	52.92		45.24					7.51	0.52	0.01	0.37					95.54
35001x05	pyrite	51.77		44.60					1.05	0.53		0.13					99.87
							0.11		2.12	0.60		0.30					99.50
58503b01	As-bearing p	51.61		43.82													
58503b02	pyrite	51.58		44.53					1.60	0.61		0.02					97.66
58503b03	As-bearing p	50.65		43.66					0.83	0.63		0.03					97.60
58503b04	As-bearing p	50.50		44.01					1.76	0.45		0.05					96.57
58503b21	Ni-bearing c	20.10		0.45	21.58	13.58			1.96	0.57		0.04					97.08
58503b22	Ni-bearing c	22.22		1.36	17.87	16.42	1.37		41.27	0.14							97.12
58503b23	Ni-bearing c	19.98		0.97	20.02	13.15	0.94		38.41	0.24		0.10					97.99
58503b24	Ni-bearing c	20.29		0.45	19.37	14.51			37.62	0.14		0.06					92.88
58503b25	Ni-bearing c	21.32		0.62	19.29	15.82	0.39		40.19	0.09		0.01					94.91
58503b26	Cu-As-Co-bea	50.72		40.44	1.10	0.45	3.01		40.13	0.14		0.02					97.73
58503b27	As-Cu-bearin	50.83		42.60	0.25	0.19	1.36		2.06	0.64		0.12					98.54
58503b29	Ni-bearing c	20.59		0.76	18.59	15.67	0.57		1.76	0.68		0.04					97.71
58503b210	Ni-bearing c	20.65		0.77	17.90	16.74	0.86		40.04	0.07		0.02					97.31
58503b212	Ni-bearing c	20.73		0.59	19.31	15.77	0.74		40.72	0.19							97.83
58503b213	Ni-bearing c	20.50		0.37	19.56	15.69			40.68	0.21							98.03
58503b214	Ni-bearing c	20.89		0.27	19.50	15.95			41.31	0.16							97.59
58503b215	Ni-bearing c	20.84		0.66	18.41	15.85	0.94		40.96	0.15		0.01					97.73
									39.60	0.21		0.11					96.62

Microprobe Analyses - Orphan Mine Samples - Weight %

Sample #	Mineral	S	Mn	Fe	Co	Ni	Cu	Zn	As	Mo	Ag	Pb	V	Se	Cd	Sb	Total
58503b216	Ni-bearing c	20.82		0.34	18.75	16.63	0.32		41.01	0.15		0.04					98.06
58503b217	Ni-bearing c	20.77		0.25	17.29	17.80			41.31	0.06		0.07					97.55
58503b218	Ni-bearing c	21.16		0.69	19.25	15.13	0.79		39.36	0.20		0.13					96.71
58503b219	Ni-Cu-bearing	21.46		2.05	18.07	15.32	1.78		38.29	0.12		0.92					98.01
58503b31	Fe-Ni-Cu-bea	29.62		11.55	14.22	11.46	1.95		28.04	0.34		0.24					97.42
58503b32	Cu-Ni-bearing	22.53		0.43	16.61	12.14	17.55		34.18	0.22							103.66
58503b33	Ni-bearing c	19.36		0.79	19.30	14.42	0.10		39.91	0.23		0.17					94.28
58503b05	As-bearing p	49.23		43.78					1.81	0.43		0.07					95.32
58503b06	As-bearing p	48.99		44.05					1.97	0.45		0.10					95.56
58503c01	As-bearing p	51.86		44.63					1.94	0.57		0.07					99.07
58503c02	As-bearing p	51.61		44.59					1.90	0.51		0.08					98.69
58503c03	pyrite	52.68		45.19					0.12	0.55							98.54
58503c04	As-bearing p	50.82		44.31					1.89	0.54		0.06					97.62
58503c05	marcasite	51.99		44.92					0.43	0.58		0.04					97.96
58503c06	marcasite	51.28		45.17					0.88	0.50		0.04					97.87
58503c07	As-bearing p	50.87		44.71					1.95	0.53		0.07					98.13
58503c08	As-bearing p	51.38		44.51					2.10	0.50		0.03					98.52
58503c09	As-bearing p	51.78		44.70					1.81	0.52		0.05					98.86
58503a01	As-bearing m	51.93		44.68					1.84	0.54		0.05					99.04
58503a02	As-bearing m	52.54		44.76					1.21	0.47		0.08					99.06
58503a03	As bearing p	51.87		44.62					1.98	0.58		0.11					99.16
58503a04	pyrite	52.42		45.23					0.58	0.51		0.01					98.75
58503a15	As-bearing p	51.42		44.34					1.89	0.51		0.05					98.21
58503a16	pyrite	52.76		45.40					0.27	0.50		0.03					98.96
58503d01	enargite?	28.58		2.19	0.38	0.04	41.66	6.29	16.42	0.22		0.02					95.80
58503d02		28.72		2.98	0.48	0.09	43.45	5.73	19.13	0.27		0.01					100.86
58503d03		27.37		2.32	1.83	0.66	40.82	5.78	21.05	0.28		0.07					100.18
58503d04	pyrite	53.47		45.21					0.36	0.50		0.07					99.61
58503b20	Ni-bearing c	20.50		0.27	20.66	14.19			40.77	0.14		0.04					96.57
58503b21	Ni-bearing c	20.48		1.01	18.84	14.65	0.41		38.94	0.19		0.04					94.56
58503x01	As-bearing p	51.54		44.20	0.04				2.28	0.49		0.07					98.62
58534x01		24.29		1.14			64.98			0.25	0.45						91.11
58534x02	As-bearing p	51.21		44.29					2.70	0.51							98.71
58534x03	As-bearing p	51.16		44.11					2.74	0.52							98.53
58534x05		22.90		0.61	0.15		76.22			0.23	0.01						100.12
9910'x01	galena	13.81								0.05		87.57					101.43

Microprobe Analyses - Orphan Mine Samples - Weight %

Sample #	Mineral	S	Mn	Fe	Co	Ni	Cu	Zn	As	Mo	Ag	Pb	V	Se	Cd	Sb	Total
9910'x02	galena	13.91								0.09		86.04					100.04
9910'x03	galena	13.90										85.12					99.02
9910'x04	sphalerite	33.71						64.21		0.44		0.10					98.46
9910'x05	pyrite	53.00		45.03		0.28			0.15	0.49		0.22					99.17
9910'x06	uraninite	0.50		0.49					1.73			6.35					9.07
9910'x07	pyrite	52.94		43.85		0.27			0.22	0.56		0.54					98.38
9910'x08	As-bearing p	51.34		44.12					2.47	0.62		0.05					98.60
9910'x10	Fe-bearing g	20.93		2.37	0.68	33.07			37.61	0.19		0.03					94.88
9910'x11	Fe-bearing g	23.81		4.62	0.36	31.43			37.02	0.13							97.37
9910'x12	Fe-bearing g	24.56		4.16	1.89	30.31			35.28	0.17		0.14					96.51
9910'x13	As-bearing p	51.72		44.50		0.11			1.46	0.45		0.11					98.35
9910'x14	Co-Fe-bearing	19.10		1.78	5.43	26.69	0.18		34.29	0.09		0.75					88.31
9910'x15	Co-Fe-bearing	19.32		1.48	3.60	29.59			37.65	0.13		0.14					91.91
9910'x16	Co-Fe-bearing	18.43		1.00	4.68	24.31	0.33		35.61	0.18		1.20					85.74
9910'x17	Fe-bearing g	20.34		2.30	0.78	32.77			41.33	0.10							97.62
9910'x18	Fe-Co-bearing	20.62		2.25	1.52	32.05			40.75	0.18							97.37
9910'x19	vaesite?	51.08		11.41	8.02	26.44	0.03		0.53	0.55		0.53					98.59
9910'x20	siegenite?	49.20		20.79	9.80	6.81	4.47		0.68	0.44	0.96	3.73					96.88
9910'x21	vaesite?	50.25		15.33	10.01	16.80	2.18		0.33	0.47	0.54	2.96					98.87
9910'x22	pyrite	52.97		43.58		0.10	0.31		0.17	0.61		0.13					97.87
9910'x23	vaesite?	51.70		9.50	8.11	28.02	0.22		0.01	0.55		0.18					98.29
9910'x25	pyrite	52.79		43.76	0.04	0.27			0.03	0.61		0.16					97.66
9910'x26	vaesite?	52.15		11.06	11.97	23.13	0.33		0.21	0.55		0.27					99.67
9910'x27	pyrite	52.69		44.68		0.13				0.52		0.15					98.17
9910'x28	vaesite?	51.99		11.07	9.23	26.07	0.14		0.07	0.50		0.18					99.25
9910'x29	vaesite?	50.05		19.04	13.16	8.81	3.55		0.53	0.48	0.81	3.63					100.06
9910'x30	bravoite	52.28		12.41	5.56	27.94	0.07			0.65		0.14					99.05
9910'x31	vaesite?	49.56		18.13	12.14	7.65	4.38		0.65	0.48	1.01	3.90					97.90
s1b11x01	bornite-mass	21.02					79.78			0.20							101.00
s1b11x02	bornite-mass	20.85					80.57			0.22							101.64
s1b11x03	bornite-mass	21.20					79.67			0.24	0.03						101.14
s1b11x04	Cu sulf -rnd	21.77					81.66			0.25	0.01						103.69
s1b11x05	Cu sulf -rnd	21.67					83.16			0.26							105.09
s1b11a01	Cu sulf -rnd	20.97					75.86			0.24	0.12						97.19
s1b11a02	Cu sulf -rnd	21.29					80.95			0.21	0.11						102.56
s1b11a03	Cu sulf -rnd	21.21					79.19			0.30	0.16						100.86
s1b11a04	Cu sulf -rnd	21.22					79.73			0.31	0.19						101.45

Microprobe Analyses - Orphan Mine Samples - Weight %

Sample #	Mineral	S	Mn	Fe	Co	Ni	Cu	Zn	As	Mo	Ag	Pb	V	Se	Cd	Sb	Total
s1b11a05	Cu sulf -rrnd	20.70					80.86			0.24	0.18						101.98
s1b11x06	chalcocite	20.67					81.09			0.26	0.05						102.07
s1b11b01	bladed grns	21.15					79.12			0.28							100.55
s1b11c01	Cu min.-lg b	21.37					79.44			0.22							101.03
s1b11d01	Cu min w/in	21.94		0.13			79.67			0.27							102.01
s1b11e01	Cu min w/in	22.16		0.20			77.42			0.24							100.02
s1b11f01	Cu min w/in	21.65		0.22			80.62			0.20							102.69
991Gx01	Cu sulf grn	24.39		6.82			60.96			0.32		0.04					92.53
991Ga01	Cu sulf grn	24.16		8.27			60.73			0.20							93.36
991Ga02	Cu sulf grn	23.35		7.56			62.98			0.31							94.20
991Gxb01	cerrusite											70.24					70.24
991Gxc01	Cu-Fe-S	26.49		10.89			62.92			0.30		0.03					100.63
991Gxc01	Cu-Fe-S	26.53		10.63			63.08			0.43							100.67
991Gxd01	Cu-S	22.48		0.17			79.02			0.31							101.98
991Gxe01	Pb-cerrusite?											72.84					72.84
991Gxf01	Cu-Fe-Zn-S g	0.01	0.16	12.49	0.51	0.73		25.57				0.51					39.98
991Gxh01	Zn-S	34.00		0.13				64.01		0.46							98.60
991Gxh02	Zn-S	33.72		0.13			0.37	64.44		0.45							99.11
991Gxi01	Cu-Fe-S	25.87		10.61			62.36			0.33							99.17
9910'x32	galena	13.97								0.07		85.32					99.36
9910'd01	pyrite	53.36		44.65		0.90				0.76		0.25					99.92
9910'd02	pyrite	52.86		42.64	0.05	1.45			0.65	0.70		0.68					99.03
9910'd03	pyrite	33.31		15.85	3.98	8.70	0.09		12.71	0.44		12.58					87.66
9910'd04	pyrite	23.15		15.61	0.77	3.84			4.73	0.35		3.09					51.54
9910'e01	pyrite cube	24.72		6.93	0.40	28.85			35.33	0.22		2.50					98.95
9910'e02	pyrite cube	53.17		44.90		0.08			1.14	0.67		0.21					100.17
9910'e03	pyrite cube	20.96		1.62	1.69	32.62			41.22	0.13							98.24
9910'e04	pyrite cube	53.33		44.53		0.07			1.14	0.63		0.13					99.83
9910'e05	pyrite cube	21.24		2.55	0.19	33.63			41.55	0.17		0.00					99.33
9910'e06	pyr cube cor	28.39		8.59	4.50	24.42	0.12		33.15	0.32		0.55					100.04
9910'e07	pyr cube rim	51.09		42.94		0.13			0.86	0.71		0.55					96.28
9910'e08	pyr cube rim	51.87		44.50					0.98	0.70		0.26					98.31
9910'f01	sphalerite	33.95						63.57		0.43		0.38					98.33
9910'f02	As-Pb-S?	13.89								0.08		85.80					99.77
9910'g01	Fe-S-As	50.93		43.80		0.00			3.27	0.59		0.04					98.63
9910'h01	pyrite core	28.09		9.95	1.85	24.70			30.45	0.25		1.17					96.46

Microprobe Analyses - Orphan Mine Samples - Weight %

Sample #	Mineral	S	Mn	Fe	Co	Ni	Cu	Zn	As	Mo	Ag	Pb	V	Se	Cd	Sb	Total
9910'h02	pyrite core	21.32		1.36	1.90	33.68			41.96	0.22							100.44
9910'h03	pyrite rim	53.49		45.40		0.10			0.36	0.71		0.19					100.25
9911'a01	pyrite vein	50.98		42.71					4.30	0.44		0.03					98.46
9911'a02	Cu vein asso	22.32		1.13			78.45			0.25							102.15
9911'a03	Cu vein asso	23.01		0.30			76.55			0.34							100.20
9911'a04	pyrite vein	51.07		42.61			0.89		3.86	0.36		0.05					98.84
9911'a05	copper vein	22.08		0.81			77.50			0.22							100.61
9911'a06	Cu-As-S vein	28.89		0.01			45.62	6.17	18.98	0.28							99.95
9911'a07	CuS	21.96					77.55			0.23		0.04					99.78
9911'a08	Cu-As-S	28.40		0.11			46.71	5.21	18.46	0.37		0.15					99.41
9911'a09	Cu-As-S	29.01		0.17			45.53	6.38	18.66	0.31		0.19					100.25
9911'a10	matrix w/ Cu	22.80					77.85			0.20							100.85
9911'a11	Cu-As-S vein	29.55		0.12			46.07	6.35	19.62	0.40							102.11
9911'a12	pyrite vein	52.08		43.05			0.03		3.94	0.44		0.08					99.62
9911'a13	pyrite vein	52.39		44.37					2.55	0.60		0.09					100.00
9911'a14	Cu-As-S	29.26		0.10			45.81	5.71	18.93	0.43							100.24
400R3b01	galena	13.12		0.06	0.00	0.00	0.08	0.00	0.00	0.00	0.00	85.76	0.05	0.00	0.13	0.02	99.22
400R3b02	galena	13.28		0.03	0.00	0.10	0.03	0.04	0.00	0.00	0.00	87.37	0.00	0.00	0.08	0.00	100.93
400R3b03	galena	13.05		0.10	0.00	0.06	0.07	0.00	0.00	0.00	0.02	86.30	0.03	0.00	0.04	0.01	99.68
400R3b05	chalcopyrite	34.28		32.34	0.05	0.00	33.43	0.11	0.01	0.41	0.00	0.00	0.01	0.01	0.00	0.00	100.64
400R3b06	chalcopyrite	34.29		31.47	0.07	0.00	30.94	0.06	0.07	0.43	0.00	0.00	0.00	0.00	0.00	0.03	97.36
400R3b04	galena	13.13		0.07	0.00	0.06	0.00	0.00	0.00	0.00	0.08	87.22	0.00	0.00	0.14	0.00	100.68
400R3b07	pyrite	53.08		45.68	0.10	0.03	0.09	0.02	0.06	0.60	0.01	0.06	0.02	0.00	0.03	0.00	99.77
400R3b08	pyrite	52.58		46.71	0.08	0.00	0.00	0.00	0.03	0.57	0.14	0.01	0.00	0.02	0.03	0.00	100.17
400R3b09	pyrite	34.59		31.71	0.10	0.00	31.90	0.05	0.06	0.44	0.04	0.07	0.00	0.01	0.04	0.00	98.99
400R3b10	pyrite	53.37		46.01	0.06	0.00	0.11	0.00	0.11	0.60	0.00	0.00	0.00	0.00	0.00	0.00	100.26
400R3b11	pyrite	53.85		47.06	0.08	0.00	0.00	0.00	0.02	0.57	0.00	0.00	0.00	0.00	0.00	0.00	101.57
400R3x01	pyrite	51.79		46.73	0.08	0.00	0.05	0.00	0.01	0.64	0.01	0.25	0.00	0.00	0.00	0.00	99.57
400R3x02	galena	13.37		0.02	0.00	0.00	0.14	0.04	0.00	0.00	0.00	86.73	0.00	0.00	0.07	0.00	100.37
400R3x03	galena	7.09		0.68	0.01	0.07	0.00	0.00	0.00	0.00	0.00	58.09	0.07	0.00	0.12	0.00	66.12
400R3a01	galena	13.25		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	85.87	0.01	0.01	0.04	0.06	99.35
400R3a02	galena	13.41		0.03	0.04	0.00	0.08	0.03	0.00	0.00	0.00	86.48	0.00	0.05	0.08	0.03	100.20
400R3a03	pyrite	53.39		46.52	0.09	0.00	0.32	0.08	0.03	0.69	0.00	0.04	0.02	0.00	0.00	0.00	101.18
400R3a04	pyrite	52.83		46.34	0.09	0.03	0.11	0.08	0.03	0.61	0.00	0.00	0.04	0.01	0.03	0.00	100.20
400R3a05	pyrite	51.28		45.63	0.07	0.00	0.26	0.04	0.11	0.48	0.05	0.76	0.04	0.01	0.00	0.00	98.73
400R3x04	pyrite	52.73		46.96	0.10	0.00	0.19	0.06	0.04	0.62	0.10	0.00	0.05	0.00	0.00	0.00	100.84

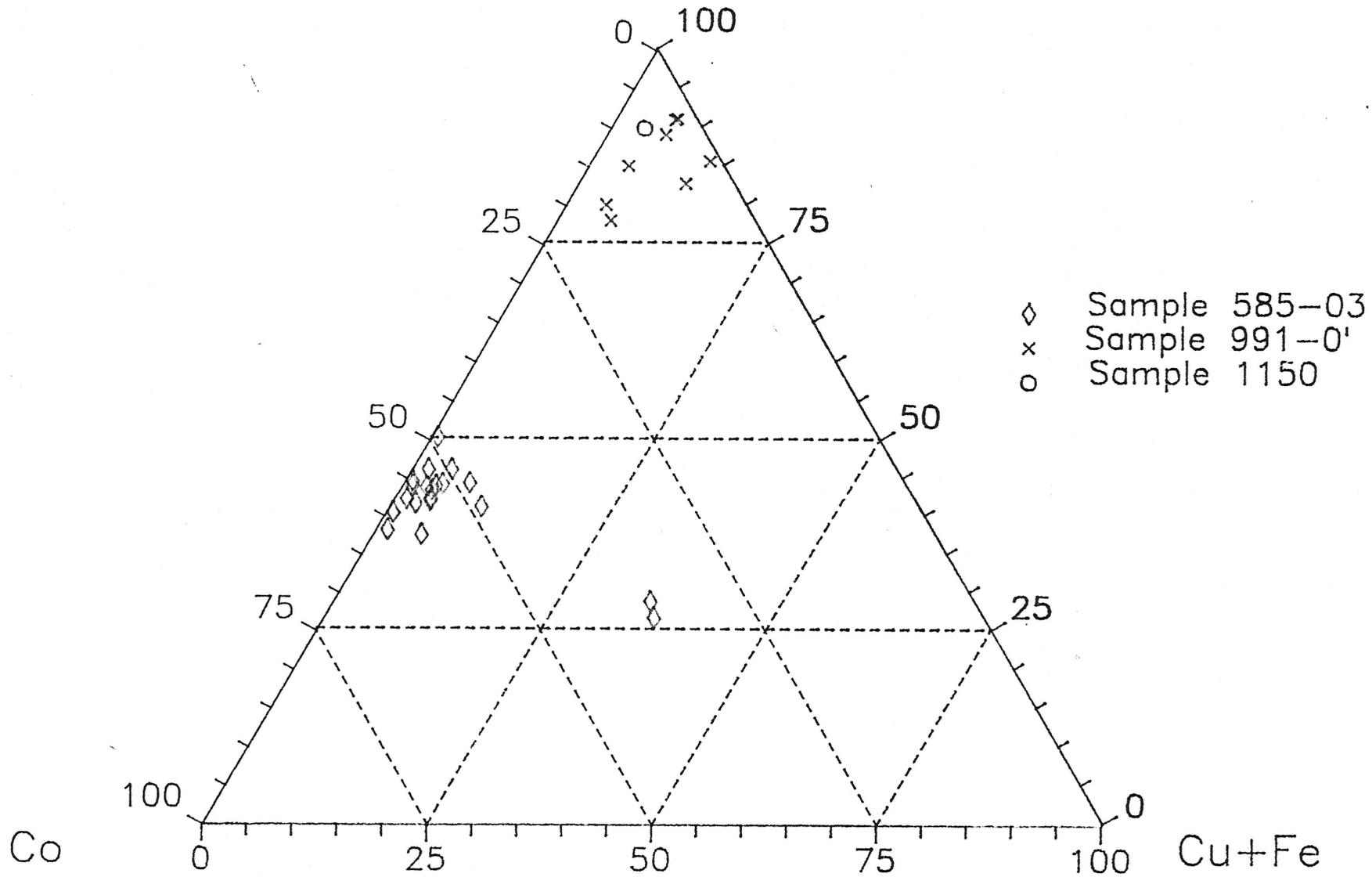
Microprobe Analyses - Orphan Mine Samples - Weight %

Sample #	Mineral	S	Mn	Fe	Co	Ni	Cu	Zn	As	Mo	Ag	Pb	V	Se	Cd	Sb	Total
400R3x05	pyrite	53.42		46.71	0.04	0.00	0.05	0.34	0.09	0.59	0.00	0.06	0.05	0.06	0.01	0.00	101.40
9916x72	chalcopyrite	33.52		30.34	0.07		33.97	0.22	0.01	0.37	0.02		0.02				98.52
*9911x72	uraninite	0.05	0.16	0.32	0.03	0.00	2.06	1.12	1.33	0.04		0.10	0.14			U=97.057	5.35
9916x71	digenite	21.95	0.06	0.91	0.00	0.02	74.65	0.00	0.00	0.37	0.00	0.03	0.00				97.99
03208b01	Cu-S	21.81					81.75			0.28							103.84
03208b02	Cu-S	21.55					80.62			0.28							102.45
03208b03	Cu-S	21.05					80.76			0.29							102.10
03208b04	Cu-S	21.05					80.88			0.26	0.18						102.37
03208b05	Cu-S	21.09					81.03			0.29	0.24						102.65
03208x06	dig/chalc ma	21.12					81.05			0.31	0.21						102.69
03208x07	dig/chalc ma	21.66					79.16			0.34							101.16
02652a01	marcasite	53.56		45.68						0.73							99.97
02652a02	pyrite worm	53.19		45.84						0.74							99.77
02652a03	pyrite	52.60		45.79					0.41	0.85		0.06					99.71
02652a04	pyrite	52.31		45.87						0.81		0.04					99.03
02652a05	marcasite	52.73		46.11						0.76		0.16					99.76
02652a06	marcasite	53.53		46.38					0.04	0.71		0.11					100.77
02652a07	marcasite	52.95		45.73						0.71		0.04					99.43
02652a08	pyrite worm	53.72		46.52						0.88		0.04					101.16
02652x01	pyrite, frac	53.43		46.77					0.08	0.73		0.11					101.12
02652x02	pyrite, frac	52.90		46.16					0.18	0.76		0.11					100.11
02652x03	Ni-cube w/in	51.39		37.37	1.32	4.61	2.61			0.77		0.34					98.41
02652x04	Ni-cube w/in	50.26		19.60	8.50	18.61	0.77		0.20	0.66		0.16					98.76
02652x05	Ni-cube w/in	49.80		23.42	8.05	14.36	0.88			0.80		0.11					97.42
02652x06	pyrite aroun	50.51		46.31					0.27	0.81		0.05					97.95
02652x07	Ni-cube w/in	49.93		40.72	1.10	2.43	1.07		1.16	0.71		0.22					97.34
02652x08	Ni-cube w/in	50.93		44.26			0.50		1.58	0.73		0.10					98.10
02652x09	pyrite	52.11		46.11						0.67		0.06					98.95
02652x10	Ni-cube w/in	51.15		26.72	5.53	13.65	0.61		0.83	0.80		0.16					99.45
02455a01	Cu-S	27.84		1.34			46.44	1.18	19.23	0.23							96.26
02455a02	Cu-S	27.98		1.32			45.45	1.29	19.36	0.34							95.74
02455a03	Cu-S	28.29		1.35			44.04	1.24	19.25	0.29							94.46
02455a04	Cu-S	28.39		1.41			43.63	0.99	19.14	0.30							93.86
02455a05	Cu-S	28.43		1.43			44.63	1.20	18.84	0.32							94.85
02455a06	Cu-S	27.98		1.37			43.50	0.94	18.89	0.30		0.04					93.02

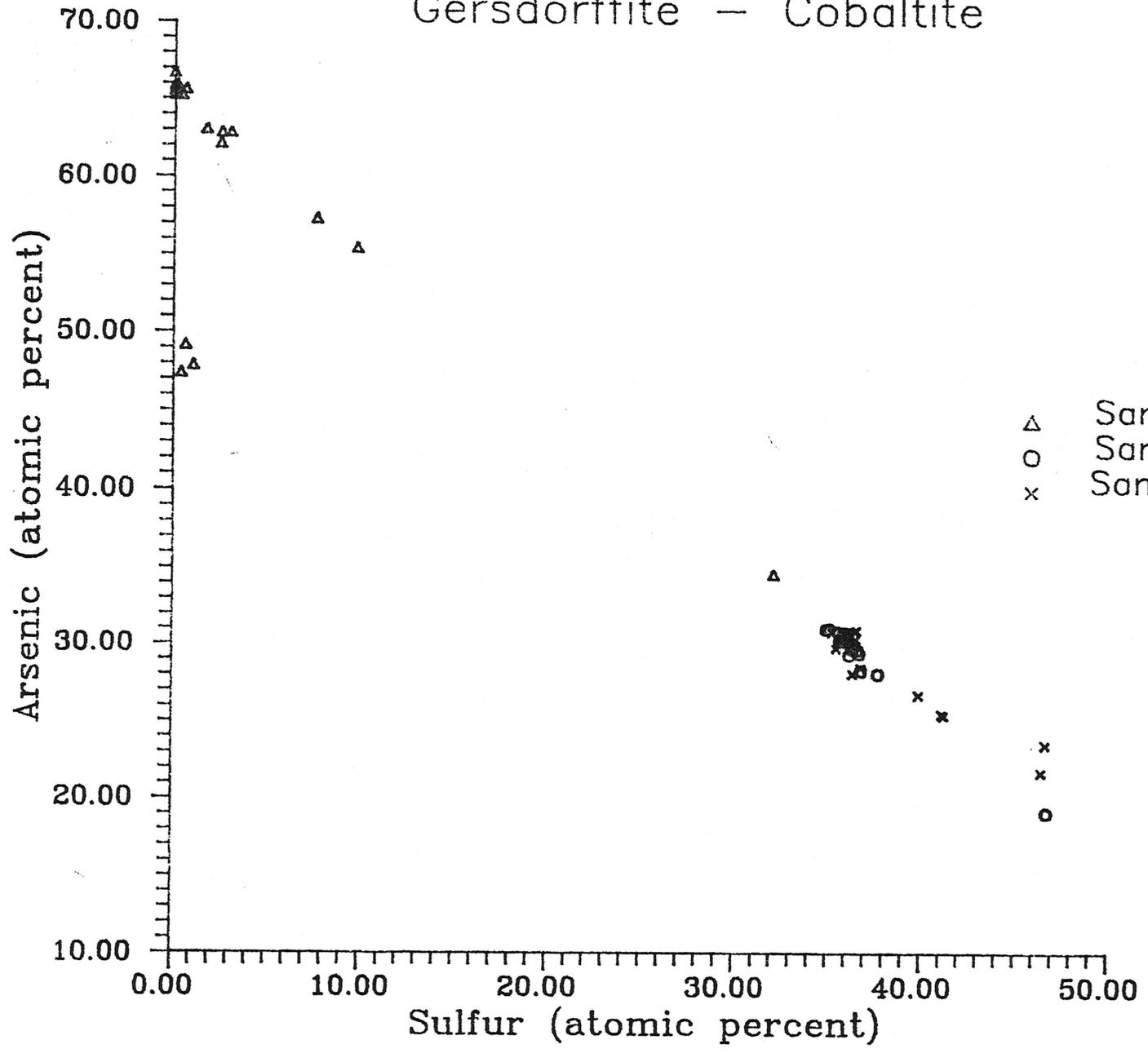
Microprobe Analyses - Orphan Mine Samples - Weight %

Sample #	Mineral	S	Mn	Fe	Co	Ni	Cu	Zn	As	Mo	Ag	Pb	V	Se	Cd	Sb	Total
02455a07	Cu-S	27.60		1.27			43.60	1.29	19.07	0.31							93.14
02455a09	digenite?	21.39					66.09		0.33	0.55							88.36
02455a10	digenite?	21.34					66.04		0.07	0.50		0.01					87.96
02455a11	digenite?	21.42					64.34		0.45	0.52		0.01					86.74
02455a13	Cu-S	28.97		1.45			48.78	0.99	19.02	0.27							99.48
02455a14	Cu-S	28.94		1.47			48.68	1.06	18.98	0.32							99.45
02455a15	Cu-S	29.11		1.44			48.99	1.08	19.21	0.28							100.11
02455a16	Cu-S	29.13		1.41			48.73	1.24	19.23	0.26							100.00
02455a17	Cu-S	29.06		1.38			48.88	1.30	19.26	0.32		0.03					100.23
02455a18	Cu-S	28.92		1.28			48.91	1.24	19.26	0.36							99.97
02455a19	Cu-S	28.87		1.36			48.79	1.37	19.32	0.26							99.97
02455a21	Cu-S	22.55					75.30		0.07	0.50							98.42
02455a22	Cu-S	22.11					75.68		0.59	0.48							98.86
02455a23	Cu-S	22.53					75.94		0.14	0.44							99.05
02455b01	Cu-As-S	28.91		1.27			48.46	1.39	19.68	0.32							100.03
02455b02	Cu-As-S	28.73		1.26			48.13	1.30	19.22	0.29							98.93
02455b03	Cu-As-S	28.71		1.22			48.45	1.35	19.36	0.42							99.51
02455b04	Cu-As-S	29.09		1.25			48.86	1.38	19.30	0.28							100.16
02455b06	Cu-S	22.63					75.77		0.13	0.47		0.03					99.03
02455b07	Cu-S	22.62					74.87		0.52	0.48	0.09						98.58
03208a01	pyrite-fract	52.58		43.68		0.06	5.14			0.68		0.09					102.23
03208a02	pyrite-fract	54.04		44.40		0.16	0.42			0.68		0.16					99.86
03208a03	pyrite-fract	53.69		44.92			0.48			0.70		0.09					99.88
03208a04	pyrite-fract	53.47		43.77		0.06	2.26			0.72		0.02					100.30
03208a06	matrix aroun	21.61		0.41			81.01			0.26	0.11						103.40
03208a07	matrix aroun	21.68		0.47	0.02		80.26			0.22	0.05						102.70
03208a08	matrix aroun	24.37		4.62	0.16		73.22		0.49	0.33	0.04	0.05					103.28
03208x01	pyrite cube	53.18		44.16			0.35			0.64		0.05					98.38
03208x02	pyrite cube	53.39		43.15			0.32			0.71		0.09					97.66
03208x03	Cu-S vein	21.51					79.05			0.18	0.18						100.92
03208x04	Cu-S vein	21.40					81.12			0.17	0.13						102.82
03208x05	Cu-S vein	21.33					81.43			0.18	0.12						103.06
03208c01	skeletal gra	20.96					78.88			0.13	0.21						100.18
03208c02	digenite?	21.20					77.78			0.32							99.30

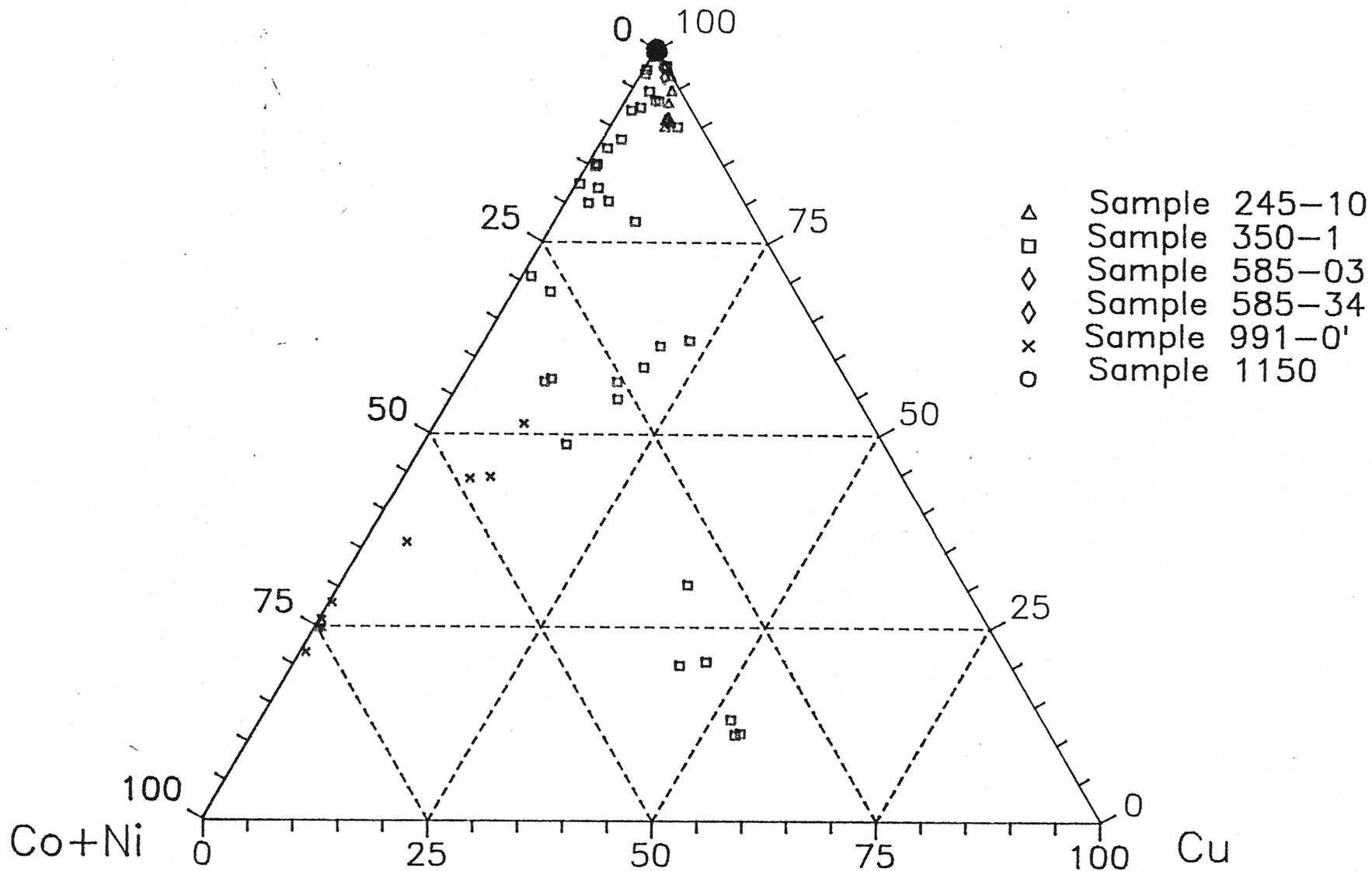
Orphan Mine
Gersdorffite & Cobaltite
Ni



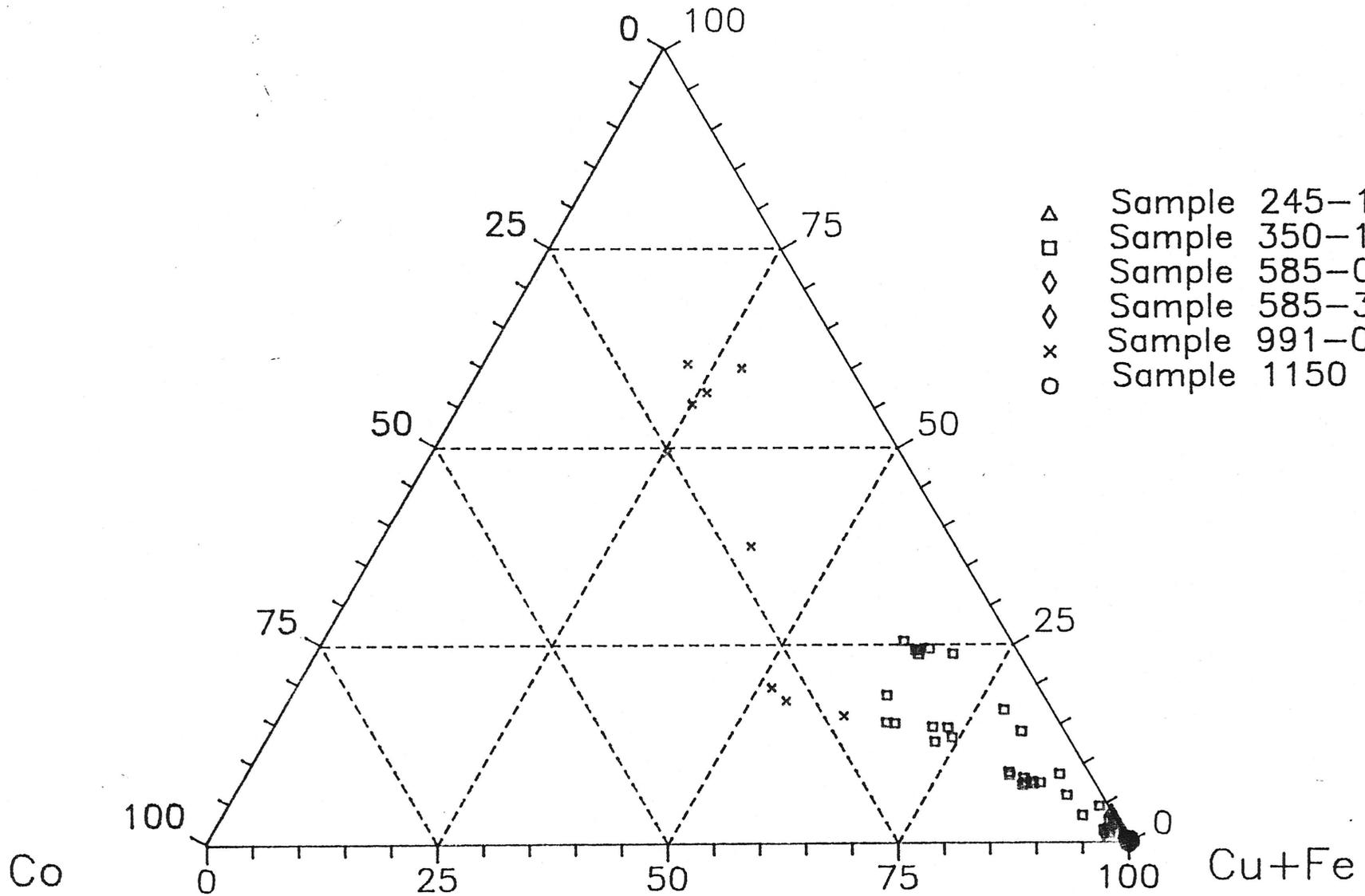
Orphan Mine Gersdorffite - Cobaltite



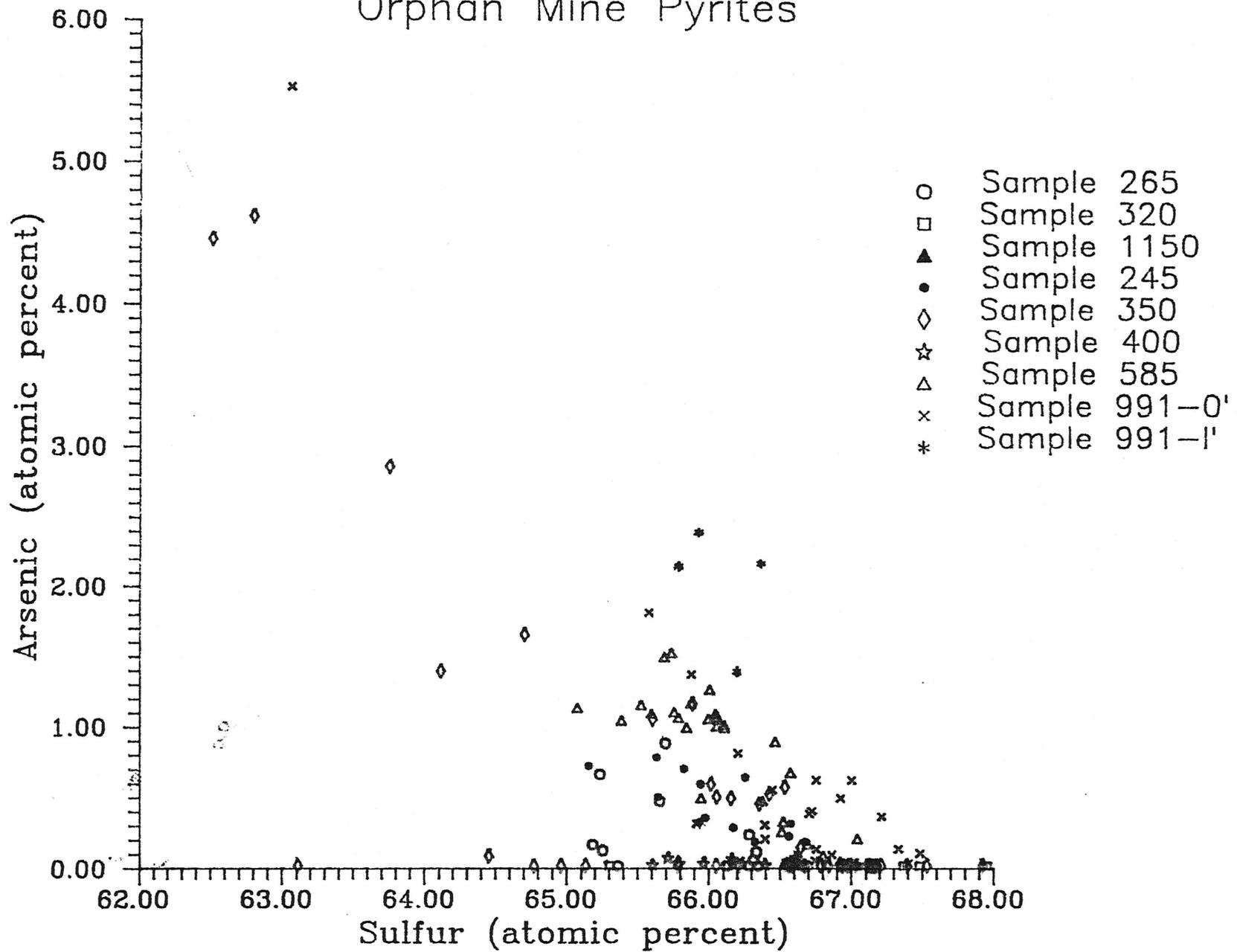
Orphan Mine Pyrites Fe



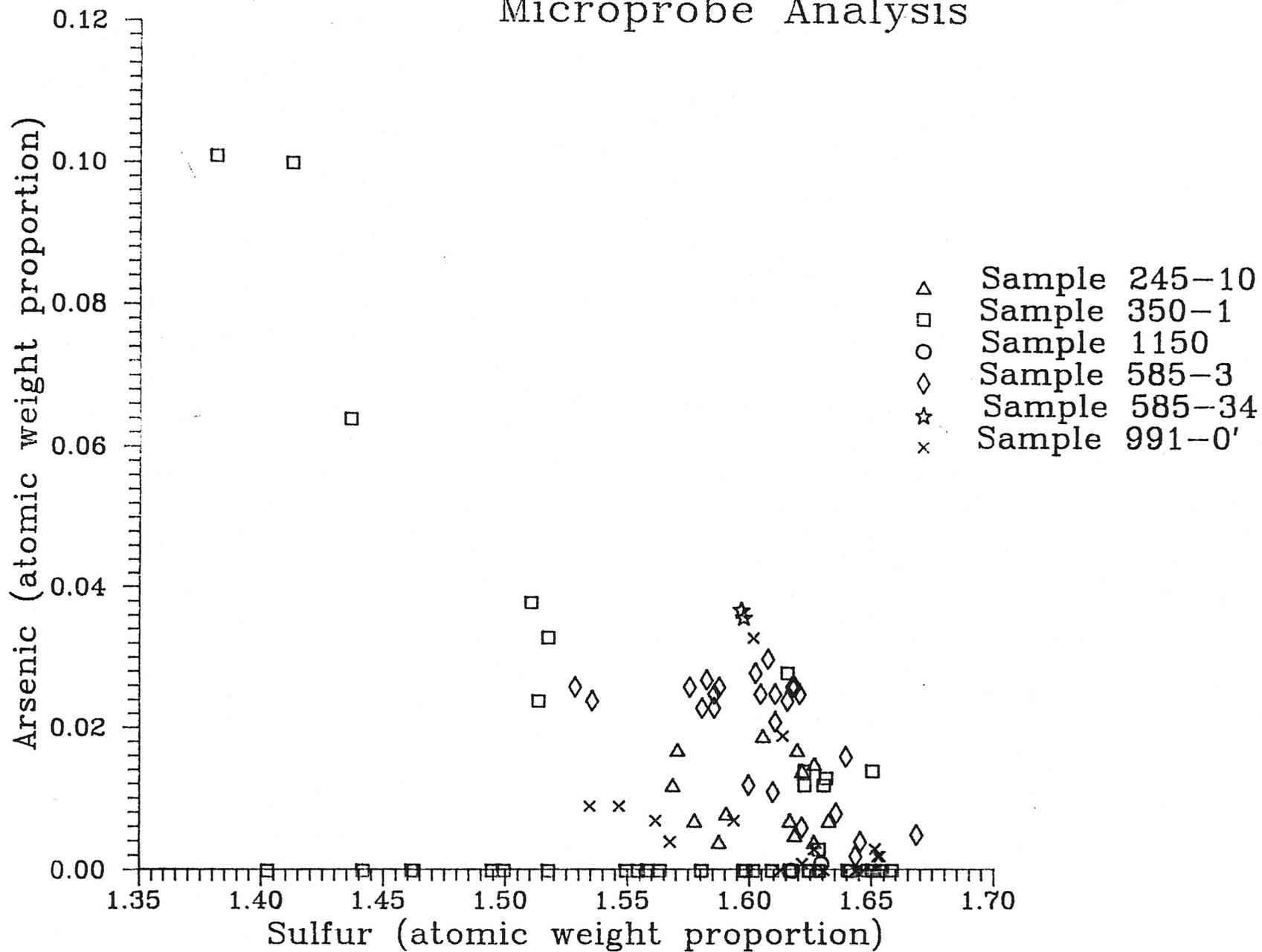
Orphan Mine Pyrites Ni



Orphan Mine Pyrites



Orphan Mine Pyrites Microprobe Analysis



6 U	2.033E-08	939.5	41.0	14.6	0.34	Jun 29 17:16 1993
7 Bi	2.018E-08	1479.5	20.6	10.5	0.34	Jun 29 16:36 1993
8 Ca	2.006E-08	3766.7	22.4	16.5	0.21	Jun 29 15:55 1993
9 Ba	2.028E-08	426.0	18.3	12.7	0.65	Jun 29 17:04 1993
10 Mg	2.006E-08	2550.9	14.5	10.0	0.26	Jun 29 15:55 1993
11 Ti	2.010E-08	4353.1	10.1	8.5	0.20	Jun 29 16:03 1993
12 O	2.027E-08	1645.5	129.4	67.5	0.34	Jun 29 17:00 1993
13 K	2.037E-08	318.3	15.7	15.5	0.55	Jun 29 17:31 1993
14 Si	2.036E-08	12406.1	36.4	23.4	0.12	May 4 15:03 1993
15 S	2.030E-08	3779.6	4.5	5.0	0.21	Jun 29 17:07 1993
16 Mo	1.986E-08	3975.4	16.8	10.0	0.21	Mar 25 13:09 1993

Unknown Specimen

Group : Wenrich

Sample : sulfideU4 ✓

UNK No. : 22

Comment : Slab 8 Gornitz x6 uraninite spot 6 Orpha

Stage : X= 40.3385

Y= 40.6030 Z= 12.6770

Dated on Jun 30 00:30 1993

WDS only

Element	Peak(mm)	Curr.(A)	Net(cps)	Bg-(cps)	Bg+(cps)	S.D.(%)
1 V	174.216	2.112E-08	14.2	39.5	29.7	14.43
2 Fe	134.735	2.112E-08	31.8	107.2	79.6	10.41
3 Cu	107.250	2.112E-08	3.1	208.3	177.1	142.17 ?
4 As	105.158	2.112E-08	5.3	32.4	23.0	32.59
5 Pb	169.211	2.112E-08	37.6	15.1	10.1	4.71
6 U	125.189	2.112E-08	1012.7	41.4	15.7	0.72
7 Bi	163.875	2.112E-08	-4.5	16.3	13.4	100.00 ?
8 Ca	107.651	2.112E-08	552.0	61.4	101.6	1.08
9 Ba	193.138	2.112E-08	2.2	25.8	19.0	71.60 ?
10 Mg	107.492	2.112E-08	2.9	35.1	21.6	61.92 ?
11 Ti	191.285	2.112E-08	3.6	27.2	20.9	44.62 ?
12 O	108.101	2.112E-08	847.4	133.5	73.8	0.86
13 K	110.674	2.112E-08	5.0	73.2	99.7	54.23 ?
14 Si	77.457	2.112E-08	35.2	114.0	68.2	9.42
15 S	172.062	2.112E-08	2.2	10.2	6.4	44.88 ?
16 Mo	173.001	2.112E-08	-0.6	12.8	9.1	100.00 ?

ZAF Metal Acc. Voltage : 15.0 (kV)

Element	Wt.(%)	Atom(%)	K(%)	ZAF	Z	A	F
V	0.152	0.2182	0.148	1.0264	0.8729	1.1759	0.9999
Fe	0.246	0.3224	0.285	0.8630	0.7876	1.0958	1.0000
Cu	0.027	0.0316	0.031	0.8914	0.8522	1.0461	0.9999
As	0.062	0.0603	0.071	0.8749	0.9171	0.9540	1.0000
Pb	1.552	0.5482	1.386	1.1200	1.0379	1.0791	1.0000
U	78.758	24.2169	80.233	0.9816	0.9952	0.9864	1.0000
Bi	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ca	2.451	4.4756	2.553	0.9602	0.7506	1.2788	1.0003
Ba	0.088	0.0470	0.089	0.9866	0.8807	1.1202	0.9999
Mg	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ti	0.047	0.0714	0.047	0.9834	0.7922	1.2414	1.0000
O	15.291	69.9458	9.188	1.6642	0.9063	1.8362	1.0000
K	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Si	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
S	0.027	0.0626	0.030	0.9290	0.8168	1.1368	1.0004
Mo	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000

Total 98.701 100.0000 94.060 Iteration = 5

UNK No. : 21 Comment : Slab 8 Gornitz x5 uraninite spot 5 Orpha
 Stage : X= 40.2570 Y= 40.7440 Z= 12.6770
 Dated on Jun 30 00:21 1993
 WDS only

Element	Peak(mm)	Curr.(A)	Net(cps)	Bg-(cps)	Bg+(cps)	S.D.(%)
1 V	174.216	2.113E-08	10.6	40.5	35.0	19.57
2 Fe	134.735	2.113E-08	20.5	116.5	82.5	16.19
3 Cu	107.250	2.113E-08	0.5	206.5	166.2	786.24 ?
4 As	105.158	2.113E-08	6.5	33.4	21.9	27.15
5 Pb	169.211	2.113E-08	41.1	18.6	10.0	4.54
6 U	125.189	2.113E-08	1013.3	42.8	16.6	0.72
7 Bi	163.875	2.113E-08	-6.0	16.1	18.2	100.00 ?
8 Ca	107.651	2.113E-08	490.5	59.7	104.4	1.17
9 Ba	193.138	2.113E-08	1.0	27.9	21.4	161.81 ?
10 Mg	107.492	2.113E-08	2.1	37.0	24.0	84.68 ?
11 Ti	191.285	2.113E-08	3.0	28.0	23.0	55.65 ?
12 O	108.101	2.113E-08	866.0	134.2	79.3	0.85
13 K	110.674	2.113E-08	0.1	70.4	101.0	1940.03 ?
14 Si	77.457	2.113E-08	37.7	114.8	66.8	8.83
15 S	172.062	2.113E-08	-1.1	10.8	9.7	100.00 ?
16 Mo	173.001	2.113E-08	-1.0	13.6	9.2	100.00 ?

ZAF Metal Acc. Voltage : 15.0 (kV)

Element	Wt.(%)	Atom(%)	K(%)	ZAF	Z	A	F
V	0.114	0.1626	0.111	1.0264	0.8728	1.1760	0.9999
Fe	0.158	0.2066	0.184	0.8629	0.7875	1.0958	1.0000
Cu	0.005	0.0056	0.005	0.8912	0.8521	1.0461	0.9999
As	0.075	0.0725	0.085	0.8746	0.9170	0.9538	1.0000
Pb	1.695	0.5960	1.514	1.1200	1.0378	1.0792	1.0000
U	78.800	24.1136	80.242	0.9820	0.9950	0.9869	1.0000
Bi	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ca	2.178	3.9584	2.267	0.9607	0.7505	1.2796	1.0003
Ba	0.040	0.0214	0.041	0.9866	0.8806	1.1203	1.0000
Mg	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ti	0.038	0.0582	0.039	0.9834	0.7921	1.2415	1.0000
O	15.553	70.8050	9.385	1.6572	0.9062	1.8287	1.0000
K	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Si	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
S	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Mo	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000

 Total 98.656 100.0000 93.873 Iteration = 5

13 K	2.037E-08	318.3	15.7	15.5	0.55	Jun 29 17:31 1993
14 Si	2.036E-08	12406.1	36.4	23.4	0.12	May 4 15:03 1993
15 S	2.030E-08	3779.6	4.5	5.0	0.21	Jun 29 17:07 1993
16 Mo	1.986E-08	3975.4	16.8	10.0	0.21	Mar 25 13:09 1993

Unknown Specimen

Group : Wenrich Sample : sulfideU4 ✓
 UNK No. : 20 Comment : Slab 8 Gornitz x4 uraninite spot 4 Orpha
 Stage : X= 40.2835 Y= 40.6845 Z= 12.6770
 Dated on Jun 30 00:12 1993
 WDS only

Element	Peak(mm)	Curr.(A)	Net(cps)	Bg-(cps)	Bg+(cps)	S.D.(%)
1 V	174.216	2.113E-08	14.3	46.5	32.2	15.13
2 Fe	134.735	2.113E-08	19.6	107.4	84.4	16.58
3 Cu	107.250	2.113E-08	13.5	208.4	166.1	32.74
4 As	105.158	2.113E-08	8.9	35.1	21.5	20.22
5 Pb	169.211	2.113E-08	48.8	14.0	10.5	3.93
6 U	125.189	2.113E-08	1010.1	43.0	15.7	0.72
7 Bi	163.875	2.113E-08	-4.1	16.5	14.6	100.00 ?
8 Ca	107.651	2.113E-08	482.4	60.5	105.2	1.18
9 Ba	193.138	2.113E-08	-1.7	29.4	20.0	100.00 ?
10 Mg	107.492	2.113E-08	-0.7	37.6	24.2	100.00 ?
11 Ti	191.285	2.113E-08	5.1	24.9	19.3	30.93
12 O	108.101	2.113E-08	847.1	138.9	78.2	0.86
13 K	110.674	2.113E-08	5.5	76.5	97.7	50.10 ?
14 Si	77.457	2.113E-08	27.4	122.3	74.5	12.31
15 S	172.062	2.113E-08	0.4	8.2	9.4	213.35 ?
16 Mo	173.001	2.113E-08	1.3	11.7	9.4	79.80 ?

ZAF Metal Acc. Voltage : 15.0 (kV)

Element	Wt.(%)	Atom(%)	K(%)	ZAF	Z	A	F
V	0.153	0.2212	0.149	1.0249	0.8714	1.1762	0.9999
Fe	0.152	0.2002	0.176	0.8614	0.7362	1.0958	0.9999
Cu	0.119	0.1379	0.133	0.8897	0.8506	1.0461	0.9998
As	0.103	0.1015	0.118	0.8732	0.9155	0.9538	1.0000
Pb	2.008	0.7153	1.796	1.1185	1.0362	1.0795	1.0000
U	78.537	24.3499	79.985	0.9819	0.9935	0.9883	1.0000
Bi	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ca	2.140	3.9398	2.230	0.9596	0.7494	1.2802	1.0003
Ba	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Mg	0.010	0.0299	0.005	2.1075	0.7834	2.6902	1.0000
Ti	0.066	0.1012	0.067	0.9820	0.7909	1.2417	1.0000
O	15.212	70.1640	9.181	1.6570	0.9041	1.8327	1.0000
K	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Si	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
S	0.006	0.0129	0.006	0.9278	0.8155	1.1372	1.0005
Mo	0.034	0.0261	0.032	1.0717	0.9435	1.1361	0.9998

 Total 98.540 100.0000 93.876 Iteration = 5

9	Ba	2.028E-08	426.0	18.3	12.7	0.65	Jun 29 17:04 1993
10	Mg	2.006E-08	2550.9	14.5	10.0	0.26	Jun 29 15:55 1993
11	Ti	2.010E-08	4353.1	10.1	8.5	0.20	Jun 29 16:03 1993
12	O	2.027E-08	1645.5	129.4	67.5	0.34	Jun 29 17:00 1993
13	K	2.037E-08	318.3	15.7	15.5	0.55	Jun 29 17:31 1993
14	Si	2.036E-08	12406.1	36.4	23.4	0.12	May 4 15:03 1993
15	S	2.030E-08	3779.6	4.5	5.0	0.21	Jun 29 17:07 1993
16	Mo	1.986E-08	3975.4	16.8	10.0	0.21	Mar 25 13:09 1993

Unknown Specimen

Group : Wenrich Sample : sulfideU4 ✓
 UNK No. : 19 Comment : Slab 8 Gornitz x3 uraninite spot 3 Orpha
 Stage : X= 40.3445 Y= 40.7185 Z= 12.6730
 Dated on Jun 30 00:04 1993
 WDS only

Element	Peak(mm)	Curr.(A)	Net(cps)	Bg-(cps)	Bg+(cps)	S.D.(%)	
1	V	174.216	2.113E-08	13.9	42.9	27.5	14.82
2	Fe	134.735	2.113E-08	30.6	112.0	79.7	10.91
3	Cu	107.250	2.113E-08	11.1	207.3	163.0	39.33 ?
4	As	105.158	2.113E-08	6.3	32.9	22.7	28.05
5	Pb	169.211	2.113E-08	34.4	16.8	10.0	5.08
6	U	125.189	2.113E-08	1020.1	44.6	12.8	0.72
7	Bi	163.875	2.113E-08	-3.7	14.2	15.3	100.00 ?
8	Ca	107.651	2.113E-08	534.6	62.9	105.5	1.11
9	Ba	193.138	2.113E-08	0.6	23.6	21.5	259.19 ?
10	Mg	107.492	2.113E-08	1.2	33.5	23.4	143.45 ?
11	Ti	191.285	2.113E-08	0.2	27.9	24.8	678.07 ?
12	O	108.101	2.113E-08	857.6	140.2	82.8	0.86
13	K	110.674	2.113E-08	1.4	69.7	99.7	192.76 ?
14	Si	77.457	2.113E-08	30.7	123.7	69.4	10.98
15	S	172.062	2.113E-08	-0.6	11.3	7.7	100.00 ?
16	Mo	173.001	2.113E-08	0.2	12.5	8.4	543.76 ?

ZAF Metal Acc. Voltage : 15.0 (kV)

Element	Wt.(%)	Atom(%)	K(%)	ZAF	Z	A	F
V	0.149	0.2124	0.145	1.0264	0.8729	1.1760	0.9999
Fe	0.237	0.3084	0.274	0.8630	0.7876	1.0958	0.9999
Cu	0.098	0.1125	0.110	0.8914	0.8522	1.0461	0.9999
As	0.072	0.0703	0.083	0.8755	0.9171	0.9546	1.0000
Pb	1.419	0.4987	1.267	1.1203	1.0379	1.0794	1.0000
U	79.261	24.2407	80.777	0.9812	0.9951	0.9860	1.0000
Bi	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ca	2.373	4.3104	2.471	0.9604	0.7506	1.2790	1.0003
Ba	0.024	0.0127	0.024	0.9866	0.8807	1.1203	0.9999
Mg	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ti	0.003	0.0047	0.003	0.9834	0.7922	1.2414	1.0000
O	15.435	70.2254	9.294	1.6606	0.9063	1.8324	1.0000
K	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Si	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
S	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Mo	0.005	0.0037	0.005	1.0734	0.9451	1.1360	0.9998

 Total 99.076 100.0000 94.454 Iteration = 5

Unknown Specimen

Group : Wenrich Sample : sulfideU4
 UNK No. : 18 Comment : Slab 8 Gornitz x2 uraninite spot 2 Orpha
 Stage : X= 40.3210 Y= 40.6770 Z= 12.6770
 Dated on Jun 29 23:56 1993
 WDS only

Element	Peak(mm)	Curr.(A)	Net(cps)	8g-(cps)	8g+(cps)	S.D.(%)
1 V	174.216	2.114E-08	12.8	44.6	31.6	16.54
2 Fe	134.735	2.114E-08	26.7	109.3	79.6	12.29
3 Cu	107.250	2.114E-08	0.5	209.8	173.2	875.01 ?
4 As	105.158	2.114E-08	8.6	33.7	22.8	20.98
5 Pb	169.211	2.114E-08	46.2	17.7	11.5	4.21
6 U	125.189	2.114E-08	1028.1	40.2	15.5	0.72
7 Bi	163.875	2.114E-08	-4.4	14.5	15.1	100.00 ?
8 Ca	107.651	2.114E-08	514.1	60.3	99.5	1.13
9 Ba	193.138	2.114E-08	1.4	26.1	21.2	116.32 ?
10 Mg	107.492	2.114E-08	0.8	35.4	23.6	232.50 ?
11 Ti	191.285	2.114E-08	-0.2	27.8	23.7	100.00 ?
12 O	108.101	2.114E-08	857.6	139.5	78.7	0.85
13 K	110.674	2.114E-08	5.6	69.6	97.5	47.52 ?
14 Si	77.457	2.114E-08	24.9	116.2	75.9	13.29
15 S	172.062	2.114E-08	0.5	9.1	8.4	197.37 ?
16 Mo	173.001	2.114E-08	-1.2	12.1	10.3	100.00 ?

ZAF Metal Acc. Voltage : 15.0 (kV)

Element	Wt.(%)	Atom(%)	K(%)	ZAF	Z	A	F
V	0.137	0.1954	0.133	1.0248	0.8712	1.1764	0.9999
Fe	0.206	0.2694	0.240	0.8614	0.7859	1.0960	1.0000
Cu	0.004	0.0051	0.005	0.8895	0.8503	1.0462	0.9998
As	0.099	0.0963	0.113	0.8730	0.9152	0.9538	1.0000
Pb	1.900	0.6688	1.699	1.1183	1.0359	1.0795	1.0000
U	79.835	24.4594	81.373	0.9811	0.9932	0.9878	1.0000
Bi	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ca	2.279	4.1467	2.375	0.9595	0.7492	1.2803	1.0003
Ba	0.055	0.0292	0.056	0.9852	0.8790	1.1209	1.0000
Mg	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ti	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
O	15.383	70.1159	9.290	1.6560	0.9037	1.8324	1.0000
K	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Si	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
S	0.006	0.0138	0.007	0.9276	0.8153	1.1373	1.0005
Mo	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000

Total 99.904 100.0000 95.290 Iteration = 5

4 As	GA3	51.7975	5.4404	0.4515	0.7690	1.0000
5 Pb	Pb8	88.6000	2.7298	1.4362	0.8337	1.0000
6 U	UO2	77.3200	1.8357	0.4515	0.7815	1.0000
7 Bi	Bi	100.0000	0.8972	0.9382	0.9253	1.0004
		13.3390	0.3675		0.0796	1.0000

11	Ti	2.010E-08	4353.1	10.1	8.5	0.20	Jun 29 15:55 1993
12	O	2.027E-08	1645.5	129.4	67.5	0.34	Jun 29 17:00 1993
13	K	2.037E-08	318.3	15.7	15.5	0.55	Jun 29 17:31 1993
14	Si	2.036E-08	12406.1	36.4	23.4	0.12	May 4 15:03 1993
15	S	2.030E-08	3779.6	4.5	5.0	0.21	Jun 29 17:07 1993
16	Mo	1.986E-08	3975.4	16.8	10.0	0.21	Mar 25 13:09 1993

Unknown Specimen

Group : Wenrich Sample : sulfideU4 ✓
 UNK No. : 16 Comment : 991-O'-C86 x13 Orphan uraninite spot 13
 Stage : X= 74.3140 Y= 24.1345 Z= 10.5720
 Dated on Jun 29 23:16 1993
 WDS only

Element	Peak (mm)	Curr. (A)	Net (cps)	Bg- (cps)	Bg+ (cps)	S.D. (%)
1 V	174.216	2.017E-08	-0.2	40.0	29.1	100.00 ?
2 Fe	134.735	2.017E-08	95.4	95.7	72.1	3.80
3 Cu	107.250	2.017E-08	-2.8	181.4	153.9	100.00 ?
4 As	105.158	2.017E-08	267.1	28.8	20.7	1.49
5 Pb	169.211	2.017E-08	128.7	14.5	9.5	2.15
6 U	125.189	2.017E-08	757.3	36.8	13.4	0.84
7 Bi	163.875	2.017E-08	-12.2	14.1	30.1	100.00 ?
8 Ca	107.651	2.017E-08	175.0	50.4	88.9	2.27
9 Ba	193.138	2.017E-08	-2.5	25.1	19.8	100.00 ?
10 Mg	107.492	2.017E-08	2.7	34.2	22.1	65.25 ?
11 Ti	191.285	2.017E-08	137.1	23.2	19.5	2.19
12 O	108.101	2.017E-08	959.3	127.6	74.4	0.79
13 K	110.674	2.017E-08	8.3	57.2	84.6	29.43
14 Si	77.457	2.017E-08	26.0	102.4	61.4	11.92
15 S	172.062	2.017E-08	53.1	8.7	6.6	3.48
16 Mo	173.001	2.017E-08	-0.3	12.1	11.6	100.00 ?

ZAF Metal Acc. Voltage : 15.0 (kV)

Element	Wt. (%)	Atom (%)	K (%)	ZAF	Z	A	F
V	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Fe	0.795	0.8832	0.897	0.8867	0.8182	1.0838	0.9999
Cu	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
As	3.240	2.6822	3.697	0.8764	0.9502	0.9223	1.0000
Pb	5.729	1.7148	4.966	1.1535	1.0732	1.0749	1.0000
U	64.628	16.8385	62.818	1.0288	1.0291	0.9997	1.0000
Bi	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ca	0.826	1.2778	0.847	0.9745	0.7765	1.2553	0.9997
Ba	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Mg	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ti	1.879	2.4331	1.882	0.9988	0.8204	1.2177	0.9998
O	18.774	72.7701	10.892	1.7237	0.9506	1.8133	1.0000
K	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Si	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
S	0.724	1.4003	0.756	0.9570	0.8446	1.1325	1.0005
Mo	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000

Total 96.595 100.0000 86.756 Iteration = 5

Unknown Specimen

Group : Wenrich

Sample : sulfideU4 ✓

UNK No. : 15

Comment : 991-O'-C86 x12 Orphan uraninite spot 12

Stage : X= 74.3395 Y= 24.1415 Z= 10.5720

Dated on Jun 29 23:06 1993

WDS only

Element	Peak (mm)	Curr. (A)	Net (cps)	Bg- (cps)	Bg+ (cps)	S.D. (%)
1 V	174.216	2.018E-08	3.8	36.5	31.7	50.57 ?
2 Fe	134.735	2.018E-08	106.6	89.9	73.9	3.45
3 Cu	107.250	2.018E-08	-0.1	189.4	151.0	100.00 ?
4 As	105.158	2.018E-08	248.0	31.7	19.8	1.56
5 Pb	169.211	2.018E-08	137.7	15.7	8.1	2.06
6 U	125.189	2.018E-08	745.6	35.8	15.0	0.85
7 Bi	163.875	2.018E-08	-12.7	16.0	26.9	100.00 ?
8 Ca	107.651	2.018E-08	178.6	57.6	83.1	2.24
9 Ba	193.138	2.018E-08	4.4	23.9	17.1	34.68 ?
10 Mg	107.492	2.018E-08	1.3	31.5	20.0	130.37 ?
11 Ti	191.285	2.018E-08	136.9	24.3	20.9	2.21
12 O	108.101	2.018E-08	864.6	114.8	62.8	0.83
13 K	110.674	2.018E-08	11.5	62.6	84.3	21.97
14 Si	77.457	2.018E-08	85.0	96.3	54.2	4.06
15 S	172.062	2.018E-08	53.0	10.7	7.9	3.58
16 Mo	173.001	2.018E-08	1.5	12.6	8.8	71.52 ?

ZAF Metal Acc. Voltage : 15.0 (kV)

Element	Wt. (%)	Atom (%)	K (%)	ZAF	Z	A	F
V	0.043	0.0563	0.041	1.0405	0.8973	1.1600	0.9997
Fe	0.882	1.0595	1.002	0.8803	0.8113	1.0852	0.9999
Cu	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
As	2.992	2.6792	3.430	0.8721	0.9426	0.9252	1.0000
Pb	6.085	1.9706	5.309	1.1462	1.0650	1.0763	1.0000
U	63.297	17.8423	61.817	1.0239	1.0212	1.0027	1.0000
Bi	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ca	0.838	1.4028	0.864	0.9696	0.7705	1.2589	0.9996
Ba	0.189	0.0925	0.190	0.9965	0.9051	1.1012	0.9998
Mg	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ti	1.865	2.6127	1.878	0.9930	0.8139	1.2203	0.9998
O	16.873	70.7555	9.811	1.7197	0.9412	1.8272	1.0000
K	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Si	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
S	0.717	1.4999	0.754	0.9509	0.8381	1.1340	1.0005
Mo	0.041	0.0288	0.038	1.0985	0.9697	1.1330	0.9998

Total 93.822 100.0000 85.135 Iteration = 4

Unknown Specimen

Group : Wenrich

Sample : sulfideU4 ✓

UNK No. : 14

Comment : 991-O'-C86 x11 Orphan uraninite spot 11

Stage : X= 74.3530

Y= 24.1135 Z= 10.5690

Dated on Jun/29 22:57 1993

WDS only

Element	Peak (mm)	Curr. (A)	Net (cps)	Bg- (cps)	Bg+ (cps)	S.D. (%)
1 V	174.216	2.021E-08	0.8	42.4	29.7	224.82 ?
2 Fe	134.735	2.021E-08	71.3	101.4	72.9	4.92
3 Cu	107.250	2.021E-08	3.8	175.0	148.6	106.45 ?
4 As	105.158	2.021E-08	248.1	33.8	21.4	1.57
5 Pb	169.211	2.021E-08	135.8	18.5	9.3	2.11
6 U	125.189	2.021E-08	758.9	34.8	12.8	0.84
7 Bi	163.875	2.021E-08	-10.5	12.1	26.7	100.00 ?
8 Ca	107.651	2.021E-08	206.1	54.4	84.0	2.01
9 Ba	193.138	2.021E-08	1.8	21.2	19.9	82.49 ?
10 Mg	107.492	2.021E-08	2.7	31.5	20.9	62.38 ?
11 Ti	191.285	2.021E-08	138.5	23.6	18.2	2.17
12 O	108.101	2.021E-08	973.9	126.1	75.1	0.79
13 K	110.674	2.021E-08	4.2	60.8	84.5	58.32 ?
14 Si	77.457	2.021E-08	27.7	100.4	62.4	11.22
15 S	172.062	2.021E-08	41.5	10.1	8.6	4.19
16 Mo	173.001	2.021E-08	0.9	12.5	9.3	117.71 ?

ZAF Metal Acc. Voltage : 15.0 (kV)

Element	Wt. (%)	Atom (%)	K (%)	ZAF	Z	A	F
V	0.010	0.0117	0.009	1.0477	0.9049	1.1581	0.9998
Fe	0.593	0.6531	0.669	0.8871	0.8185	1.0839	0.9999
Cu	0.036	0.0353	0.039	0.9248	0.8889	1.0409	0.9995
As	3.006	2.4677	3.427	0.8772	0.9506	0.9228	1.0000
Pb	6.029	1.7896	5.230	1.1529	1.0736	1.0738	1.0000
U	64.683	16.7116	62.832	1.0294	1.0295	0.9999	1.0000
Bi	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ca	0.971	1.4895	0.996	0.9748	0.7768	1.2552	0.9997
Ba	0.077	0.0346	0.077	1.0029	0.9127	1.0990	0.9998
Mg	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ti	1.896	2.4341	1.897	0.9994	0.8207	1.2179	0.9999
O	19.064	73.2760	11.035	1.7276	0.9510	1.8166	1.0000
K	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Si	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
S	0.563	1.0806	0.589	0.9564	0.8449	1.1314	1.0005
Mo	0.025	0.0160	0.023	1.1047	0.9776	1.1303	0.9998

Total 96.953 100.0000 86.823 Iteration = 5

1 V	V	100.0000	0.5082	0.5216	0.9741	1.0000
2 Fe	Fe12	46.5533	0.2107	0.2168	0.9718	1.0000
3 Cu	Cu	100.0000	0.0955	0.0966	0.9901	1.0000

13 K	2.037E-08	318.3	15.7	15.5	0.55	Jun 29 17:31 1993
14 Si	2.036E-08	12406.1	36.4	23.4	0.12	May 4 15:03 1993
15 S	2.030E-08	3779.6	4.5	5.0	0.21	Jun 29 17:07 1993
16 Mo	1.986E-08	3975.4	16.8	10.0	0.21	Mar 25 13:09 1993

Unknown Specimen

Group : Wenrich Sample : sulfideU4 ✓
 UNK No. : 13 Comment : 991-O'-C86 x10 Orphan uraninite spot 10
 Stage : X= 74.3745 Y= 24.0740 Z= 10.5755
 Dated on Jun 29 22:49 1993
 WDS only

Element	Peak(mm)	Curr.(A)	Net(cps)	Bg-(cps)	Bg+(cps)	S.D.(%)
1 V	174.216	2.021E-08	2.9	32.9	30.5	62.78 ?
2 Fe	134.735	2.021E-08	77.5	93.8	69.5	4.48
3 Cu	107.250	2.021E-08	5.6	172.2	141.8	71.37 ?
4 As	105.158	2.021E-08	251.4	32.5	18.0	1.54
5 Pb	169.211	2.021E-08	143.6	14.5	9.6	2.02
6 U	125.189	2.021E-08	703.4	35.3	14.9	0.87
7 Bi	163.875	2.021E-08	-11.3	12.9	29.6	100.00 ?
8 Ca	107.651	2.021E-08	184.5	54.4	79.0	2.16
9 Ba	193.138	2.021E-08	1.8	21.0	19.2	81.34 ?
10 Mg	107.492	2.021E-08	5.9	29.6	21.7	29.17
11 Ti	191.285	2.021E-08	136.4	22.0	20.8	2.20
12 O	108.101	2.021E-08	940.8	112.3	62.4	0.79
13 K	110.674	2.021E-08	11.2	64.0	78.6	22.44
14 Si	77.457	2.021E-08	234.0	98.0	59.5	1.90
15 S	172.062	2.021E-08	64.8	8.0	7.5	3.09
16 Mo	173.001	2.021E-08	0.1	12.1	8.9	1559.74 ?

ZAF Metal Acc. Voltage : 15.0 (kV)

Element	Wt.(%)	Atom(%)	K(%)	ZAF	Z	A	F
V	0.033	0.0412	0.032	1.0505	0.9087	1.1562	0.9998
Fe	0.647	0.7309	0.727	0.8900	0.8223	1.0825	0.9999
Cu	0.054	0.0536	0.058	0.9288	0.8934	1.0403	0.9994
As	3.045	2.5653	3.473	0.8769	0.9546	0.9186	1.0000
Pb	6.391	1.9468	5.530	1.1557	1.0779	1.0722	1.0000
U	60.335	15.9966	58.238	1.0360	1.0337	1.0022	1.0000
Bi	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ca	0.871	1.3713	0.892	0.9767	0.7800	1.2526	0.9997
Ba	0.078	0.0357	0.077	1.0051	0.9166	1.0968	0.9998
Mg	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ti	1.871	2.4649	1.868	1.0015	0.8241	1.2154	0.9999
O	18.522	73.0561	10.660	1.7375	0.9560	1.8174	1.0000
K	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Si	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
S	0.882	1.7364	0.920	0.9587	0.8483	1.1296	1.0005
Mo	0.002	0.0012	0.002	1.1074	0.9815	1.1285	0.9998

 Total 92.731 100.0000 82.477 Iteration = 5

Unknown Specimen

Group : Wenrich Sample : sulfideU4
 UNK No. : 11 Comment : 991-O'-C86 x8 Orphan mine uraninite spt8
 Stage : X= 70.2940 Y= 21.0855 Z= 10.5780
 Dated on Jun/29 22:23 1993
 WDS only

Element	Peak (mm)	Curr. (A)	Net (cps)	Bg- (cps)	Bg+ (cps)	S.D. (%)
1 V	174.216	2.026E-08	4.2	37.0	26.2	43.22 ?
2 Fe	134.735	2.026E-08	57.3	91.9	67.9	5.75
3 Cu	107.250	2.026E-08	-0.5	181.6	147.2	100.00 ?
4 As	105.158	2.026E-08	251.6	29.8	19.0	1.54
5 Pb	169.211	2.026E-08	133.7	16.4	9.1	2.11
6 U	125.189	2.026E-08	747.6	36.1	13.0	0.84
7 Bi	163.875	2.026E-08	-12.4	13.5	29.7	100.00 ?
8 Ca	107.651	2.026E-08	247.4	55.5	78.8	1.77
9 Ba	193.138	2.026E-08	0.3	24.5	18.4	591.81 ?
10 Mg	107.492	2.026E-08	5.1	31.4	17.4	33.26
11 Ti	191.285	2.026E-08	123.5	23.3	21.6	2.36
12 O	108.101	2.026E-08	858.5	106.8	56.7	0.83
13 K	110.674	2.026E-08	4.4	63.2	87.3	56.83 ?
14 Si	77.457	2.026E-08	229.7	99.1	62.1	1.93
15 S	172.062	2.026E-08	37.3	7.9	7.9	4.37
16 Mo	173.001	2.026E-08	-0.4	10.2	10.0	100.00 ?

ZAF Metal Acc. Voltage : 15.0 (kV)

Element	Wt. (%)	Atom (%)	K (%)	ZAF	Z	A	F
V	0.048	0.0645	0.046	1.0410	0.8965	1.1614	0.9998
Fe	0.472	0.5748	0.536	0.8799	0.8105	1.0857	0.9999
Cu	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
As	3.018	2.7425	3.467	0.8704	0.9418	0.9241	1.0000
Pb	5.882	1.9331	5.134	1.1457	1.0641	1.0766	1.0000
U	63.106	18.0518	61.740	1.0221	1.0204	1.0017	1.0000
Bi	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ca	1.157	1.9652	1.193	0.9699	0.7699	1.2601	0.9998
Ba	0.011	0.0053	0.011	0.9972	0.9043	1.1029	0.9999
Mg	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ti	1.677	2.3841	1.688	0.9937	0.8132	1.2222	0.9999
O	16.734	71.2131	9.704	1.7245	0.9401	1.8345	1.0000
K	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Si	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
S	0.502	1.0655	0.528	0.9505	0.8375	1.1344	1.0005
Mo	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
<hr/>							
Total	92.607	100.0000	84.046	Iteration = 4			

Unknown Specimen

Group : Wenrich Sample : sulfideU4
 UNK No. : 10 Comment : 991-O'-C86 x7 Orphan mine uraninite spt7
 Stage : X= 70.2835 Y= 21.0675 Z= 10.5730 ✓
 Dated on Jun 29 22:15 1993
 WDS only

Element	Peak (mm)	Curr. (A)	Net (cps)	Bg- (cps)	Bg+ (cps)	S.D. (%)
1 V	174.216	2.027E-08	4.4	35.8	29.7	42.48 ?
2 Fe	134.735	2.027E-08	60.3	95.1	71.9	5.59
3 Cu	107.250	2.027E-08	2.2	177.6	150.3	180.59 ?
4 As	105.158	2.027E-08	261.8	31.2	21.4	1.51
5 Pb	169.211	2.027E-08	142.2	16.3	8.0	2.03
6 U	125.189	2.027E-08	771.5	37.5	16.1	0.83
7 Bi	163.875	2.027E-08	-12.8	13.5	28.6	100.00 ?
8 Ca	107.651	2.027E-08	250.6	54.4	86.2	1.77
9 Ba	193.138	2.027E-08	-0.9	25.0	21.9	100.00 ?
10 Mg	107.492	2.027E-08	4.2	34.0	19.4	41.62 ?
11 Ti	191.285	2.027E-08	124.4	27.4	20.3	2.36
12 O	108.101	2.027E-08	855.0	121.0	66.8	0.84
13 K	110.674	2.027E-08	7.5	62.6	84.1	33.46 ?
14 Si	77.457	2.027E-08	160.0	100.6	59.9	2.51
15 S	172.062	2.027E-08	54.4	8.5	6.6	3.43
16 Mo	173.001	2.027E-08	2.3	11.9	7.9	46.65 ?

ZAF Metal Acc. Voltage : 15.0 (kV)

Element	Wt. (%)	Atom (%)	K (%)	ZAF	Z	A	F
V	0.050	0.0659	0.048	1.0390	0.8942	1.1621	0.9998
Fe	0.495	0.5969	0.564	0.8778	0.8084	1.0860	0.9999
Cu	0.021	0.0225	0.023	0.9132	0.8771	1.0418	0.9994
As	3.129	2.8136	3.605	0.8679	0.9395	0.9238	1.0000
Pb	6.242	2.0298	5.460	1.1433	1.0616	1.0769	1.0000
U	65.053	18.4128	63.687	1.0215	1.0179	1.0034	1.0000
Bi	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ca	1.170	1.9660	1.207	0.9688	0.7680	1.2617	0.9998
Ba	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Mg	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ti	1.685	2.3696	1.698	0.9921	0.8112	1.2231	0.9999
O	16.658	70.1430	9.659	1.7246	0.9371	1.8403	1.0000
K	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Si	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
S	0.731	1.5367	0.771	0.9485	0.8355	1.1347	1.0005
Mo	0.062	0.0433	0.056	1.0956	0.9666	1.1337	0.9998

Total 95.296 100.0000 86.779 Iteration = 4

1 V	V	100.0000	0.8082	0.8210	0.9771	1.0000
2 Fe	Fe32	46.5533	0.2107	0.2163	0.9718	1.0000
3 Cu	Cu	100.0000	0.0956	0.0956	0.9901	1.0000
4 As	AsAs	51.7976	3.4462	9.3880	0.3672	1.0000

3	Cu	2.011E-08	9599.0	108.4	87.9	0.13	Jun 29 16:10 1993
4	As	2.012E-08	3733.2	26.6	34.6	0.21	Jun 29 16:14 1993
5	Pb	2.031E-08	2260.2	69.0	13.5	0.28	Jun 29 17:11 1993
6	U	2.033E-08	939.5	41.0	14.6	0.34	Jun 29 17:16 1993
7	Bi	2.018E-08	1479.5	20.6	10.5	0.34	Jun 29 16:36 1993
8	Ca	2.006E-08	3766.7	22.4	16.5	0.21	Jun 29 15:55 1993
9	Ba	2.028E-08	426.0	13.3	12.7	0.65	Jun 29 17:04 1993
10	Mg	2.006E-08	2550.9	14.5	10.0	0.26	Jun 29 15:55 1993
11	Ti	2.010E-08	4353.1	10.1	8.5	0.20	Jun 29 16:03 1993
12	O	2.027E-08	1645.5	129.4	67.5	0.34	Jun 29 17:00 1993
13	K	2.037E-08	318.8	15.7	15.5	0.55	Jun 29 17:31 1993
14	Si	2.036E-08	12405.1	36.4	23.4	0.12	May 4 15:03 1993

Unknown Specimen
 Group : Wanrich Sample : sulfideU4
 UNK No. : 7 Comment : 991-O'-C86 Orphan mine uraninite random4
 Stage : X= 64.5805 Y= 28.0150 Z= 10.5605
 Dated on Jun 29 21:32 1993
 WDS only

Element	Peak (mm)	Curr. (A)	Net (cps)	3g- (cps)	3g+ (cps)	S.D. (%)
1 V	174.216	2.032E-08	4.1	34.1	25.7	43.60 ?
2 Fe	134.735	2.032E-08	96.3	91.0	68.2	3.71
3 Cu	107.250	2.032E-08	3.9	163.6	138.6	100.29 ?
4 As	105.153	2.032E-08	356.0	29.3	19.0	1.25
5 Pb	169.211	2.032E-08	176.4	17.1	9.5	1.81
6 U	125.139	2.032E-08	641.9	31.9	14.3	0.91
7 Bi	163.875	2.032E-08	-14.0	11.2	35.1	100.00 ?
8 Ca	107.651	2.032E-08	133.6	52.7	79.6	2.73
9 Ba	193.133	2.032E-08	-0.5	23.0	13.2	100.00 ?
10 Mg	107.492	2.032E-08	3.6	23.1	21.1	45.93 ?
11 Ti	191.285	2.032E-08	174.4	21.2	20.3	1.89
12 O	108.101	2.032E-08	1023.4	117.6	63.5	0.76
13 K	110.674	2.032E-08	6.4	56.4	81.7	37.93 ?
14 Si	77.457	2.032E-08	159.6	90.2	59.3	2.36

ZAF Metal Acc. Voltage : 15.0 (kV)

Element	Wt. (%)	Atom (%)	K (%)	ZAF	Z	A	F
V	0.047	0.0554	0.045	1.0563	0.9190	1.1498	0.9997
Fe	0.305	0.3653	0.399	0.8971	0.8323	1.0731	0.9998
Cu	0.033	0.0357	0.040	0.9893	0.9053	1.0384	0.9992
As	4.239	3.4315	4.391	0.8759	0.9652	0.9085	1.0000
Pb	7.292	2.2833	6.757	1.1681	1.0392	1.0724	1.0000
U	55.502	13.9762	52.856	1.0501	1.0446	1.0052	1.0000
Bi	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ca	0.629	0.9403	0.642	0.9793	0.7883	1.2430	0.9994
Ba	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Mg	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ti	2.389	2.9397	2.376	1.0054	0.8332	1.2069	0.9998
O	20.133	75.4222	11.533	1.7457	0.9692	1.8011	1.0000
K	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Si	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000

Total	91.725	100.0000	80.040	Iteration = 5			

6	U	2.033E-08	939.5	41.0	14.6	0.34	Jun 29 17:16 1993
7	Ba	2.018E-08	1479.5	20.6	10.5	0.34	Jun 29 16:36 1993
8	Ca	2.006E-08	3766.7	22.4	16.5	0.21	Jun 29 15:55 1993
9	Ba	2.028E-08	426.0	18.3	12.7	0.65	Jun 29 17:04 1993
10	Mg	2.006E-08	2550.9	14.5	10.0	0.26	Jun 29 15:55 1993
11	Ti	2.010E-08	4353.1	10.1	8.5	0.20	Jun 29 16:03 1993
12	O	2.027E-08	1645.5	129.4	67.5	0.34	Jun 29 17:00 1993
13	K	2.037E-08	318.3	15.7	15.5	0.55	Jun 29 17:31 1993

Unknown Specimen

Group : Wenrich Sample : sulfideU4
 UMK No. : a Comment : 991-O'-C86 Orphan mine uraninite random
 Stage : X= 65.5350 Y= 30.1725 Z= 10.5515
 Dated on Jun 29 20:35 1993
 WDS only

Element	Peak (mm)	Curr. (A)	Net (cps)	Bg- (cps)	Bg+ (cps)	S.D. (%)	
1	V	174.216	1.989E-08	1.4	34.2	29.9	124.86 ?
2	Fe	134.735	1.989E-08	77.7	94.7	68.3	4.47
3	Cu	107.250	1.989E-08	-2.8	172.9	152.4	100.00 ?
4	As	105.156	1.989E-08	252.0	34.6	21.0	1.55
5	Pb	159.211	1.989E-08	199.1	16.0	10.0	1.68
6	U	125.189	1.989E-08	635.0	35.0	13.6	0.33
7	Ba	153.875	1.989E-08	-17.4	12.4	42.4	100.00 ?
8	Ca	107.651	1.989E-08	180.8	58.6	73.4	2.21
9	Ba	193.138	1.989E-08	2.0	24.6	18.0	75.79 ?
10	Mg	107.492	1.989E-08	4.5	29.0	21.5	37.45 ?
11	Ti	191.285	1.989E-08	150.1	22.8	21.3	2.06
12	O	103.101	1.989E-08	906.4	121.1	70.4	0.32
13	K	110.674	1.989E-08	11.1	58.2	79.4	22.04

ZAF Metal Acc. Voltage : 15.0 (KV)

Element	Wt. (%)	Atom (%)	K (%)	ZAF	Z	A	F
V	0.017	0.0214	0.016	1.0439	0.9018	1.1579	0.9993
Fe	0.654	0.7595	0.740	0.8831	0.8157	1.0828	0.9998
Cu	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
As	3.077	2.6650	3.537	0.8701	0.9473	0.9125	1.0000
Pb	8.945	2.3009	7.792	1.1480	1.0700	1.0729	1.0000
U	59.596	16.2711	57.623	1.0360	1.0260	1.0097	1.0000
Ba	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ca	0.363	1.3565	0.883	0.9719	0.7742	1.2559	0.9996
Ba	0.037	0.0413	0.037	0.9992	0.9096	1.0937	0.9993
Mg	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
Ti	2.079	2.8163	2.033	0.9956	0.8179	1.2175	0.9999
O	18.059	73.2280	10.436	1.7305	0.9472	1.5269	1.0000
K	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000

 Total 93.477 100.0000 83.207 Iteration = 5

RECLAMATION REPORT
ORPHAN MINE
GRAND CANYON NATIONAL PARK, ARIZONA

by

Moon Hom
Mining Engineer

U.S. DEPARTMENT OF INTERIOR
Bureau of Land Management
Phoenix District Office
Division of Mineral Resources

June 1986

RECLAMATION REPORT - ORPHAN MINE

GRAND CANYON NATIONAL PARK, ARIZONA

INTRODUCTION

The Orphan Mine is located on the South Rim of the Grand Canyon approximately halfway between Hopi Point and Maricopa Point and near the Powell Memorial (Figure 1). This location is approximately two miles west of the Grand Canyon Village. The mine was worked as a copper mine and then as a uranium mine during different time periods since it was first patented. Based on a public law passed in 1962, the current mine site will be acquired by the National Park Service at the end of May 1987. In anticipation of this acquisition, personnel from the U.S. Bureau of Land Management (BLM) surveyed the mine site in order to develop abandonment and reclamation recommendations.

HISTORICAL BACKGROUND

The Orphan lode claim covering approximately 20.3 acres was patented in 1906 for copper mineralization contained in a breccia pipe structure situated approximately 1100 feet below the South Rim of the Grand Canyon National Park (Figure 2). The mining activities that occurred on the Orphan lode claim came to be known as the Orphan Mine. Copper mining occurred at the Orphan at various times during the period from 1906 to 1946. In 1953, after the discovery of uranium, the mineral rights were leased and later acquired (both estates) by a subsidiary of Western Gold and Uranium Inc., later renamed Western Equities, Inc.

Western Gold built in 1956 an aerial tramway from the adit area to the rim in order to facilitate the removal of uranium ore. From 1956 to 1959, production averaged 1000 tons per month of 1.00% U₃O₈ from mining faces at four different levels below the adit. In addition to the construction of the aerial tramway, the company constructed offices, storage buildings, and living quarters along with a water tank. The cabins and Grand Canyon Inn shown on Figure 2 were built by the previous claim owner.

Production was expanded in late 1959 by the construction of 2½ compartment shaft (two 5 foot by 5 foot hoisting compartments and a 3 foot by 5 foot manway). The shaft was collared with concrete and utilized steel sets and fireproof wooden lagging. The shaft was driven to a depth of approximately 1600 feet below the elevation of the rim. A 1200 foot horizontal drift was then driven from the 1500 foot level of the shaft to the 400 foot level of the existing workings in the adit area (Figure 3). The first ore was hoisted through the shaft in November 1959 and, shortly thereafter, the shaft became the primary haulage system of ore, men, and materials to and from the active mining area. Production in 1960 was at an average rate of approximately 6400 tons per month of 0.30% U₃O₈. Most of the ore was transported by truck to the Tuba City mill for further processing. Ore was also shipped by railroad to a uranium mill in Grants, NM.

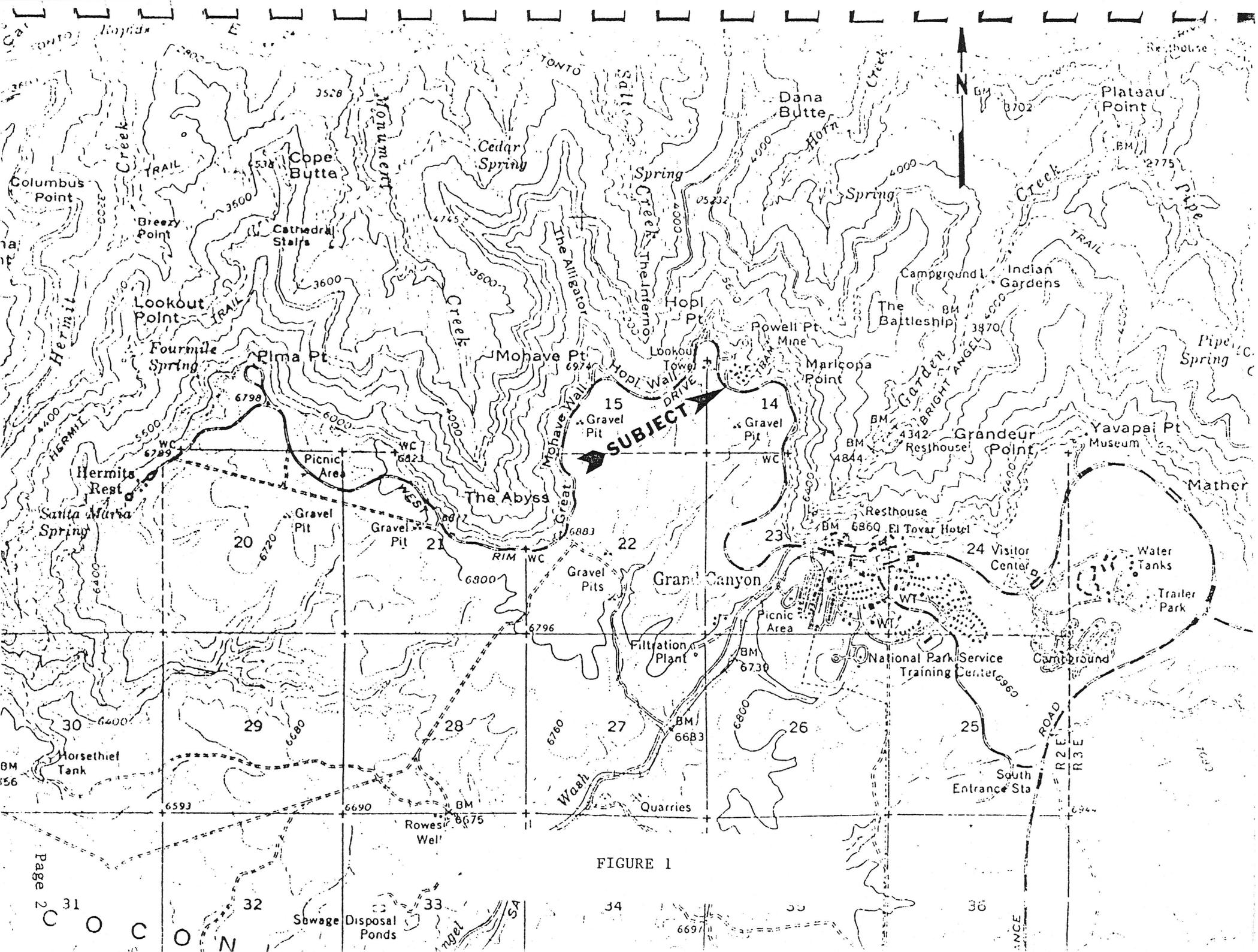


FIGURE 1

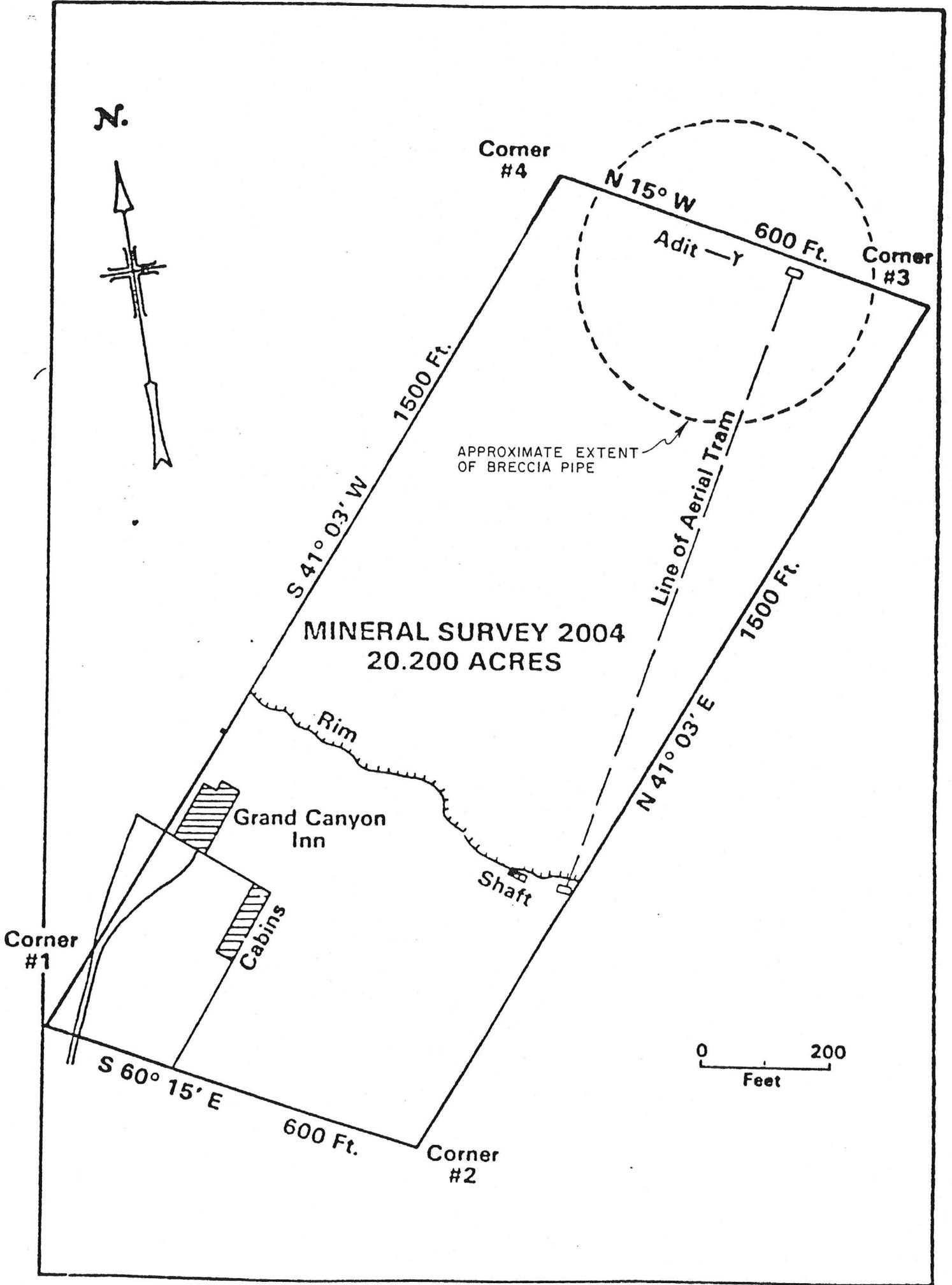


FIGURE 2 Orphan lode claim map

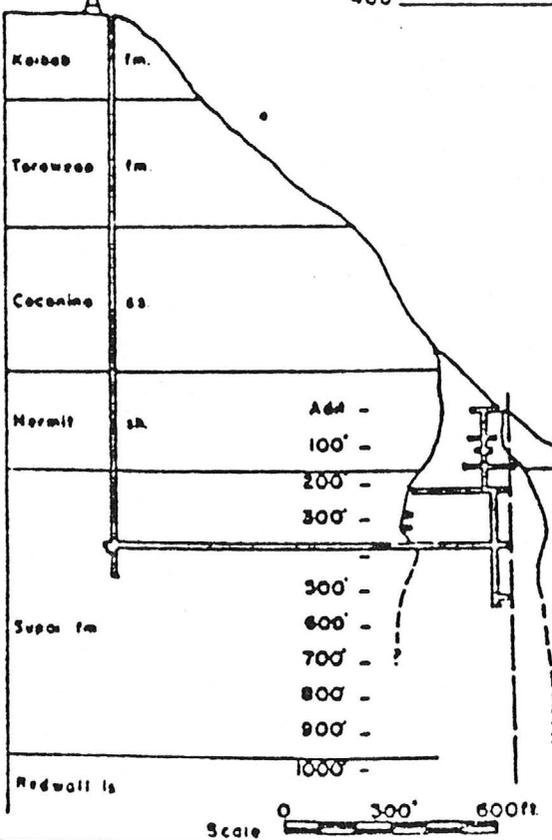
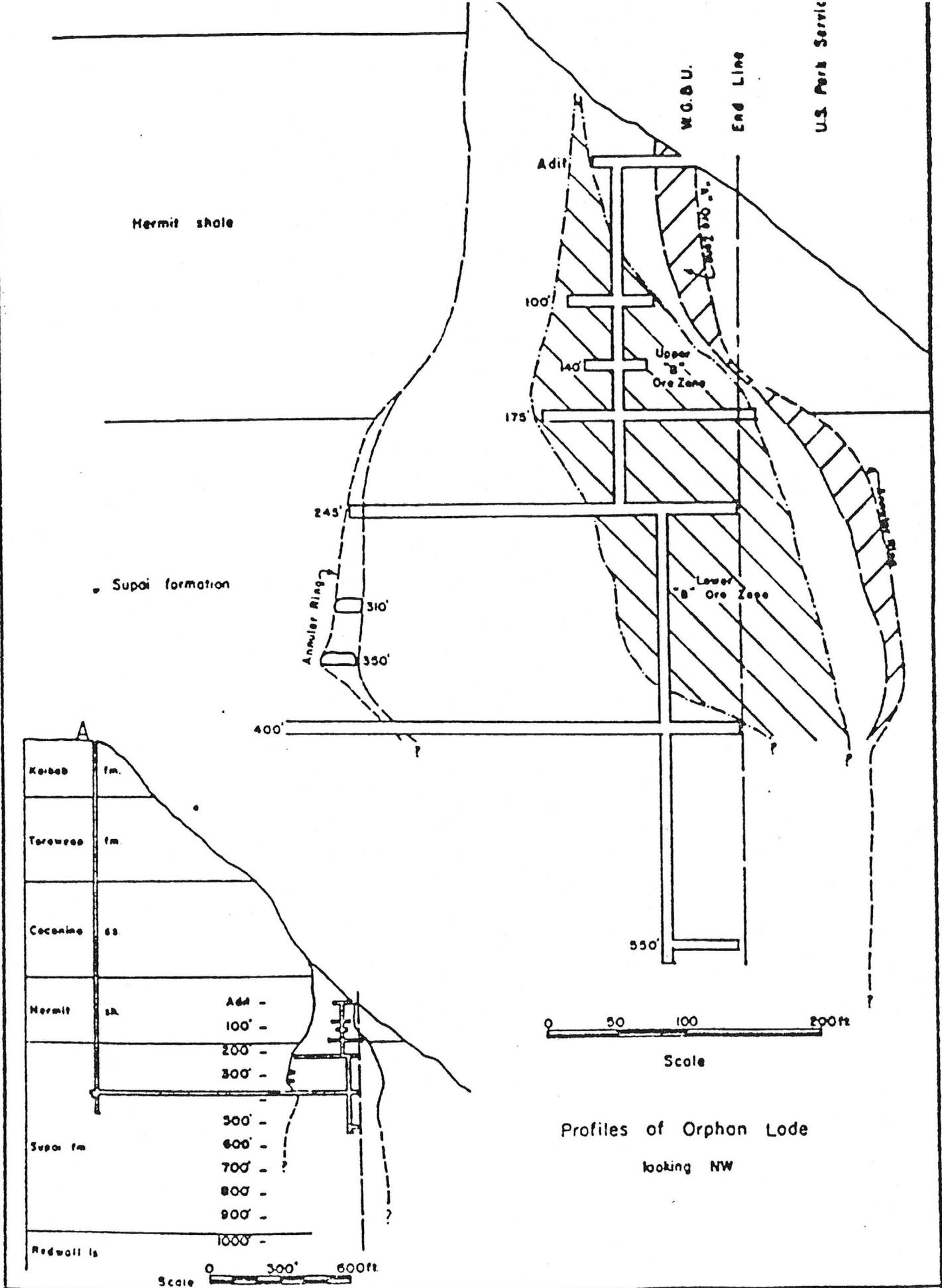


Figure 3 Orphan Lode Coconino County, Arizona

Below the 175 foot level of the mine, the mineralized zones extends beyond the end line of the patented claim (Figure 3). In order to mine ore beyond the end line under the Park property, permission was needed from the U. S. Congress. On May 28, 1962, Public Law 87-457 became effective which allowed additional mining to occur for a period of 25 years. In exchange for the permission to mine, the patented claim was reduced in size to approximately 3.0 acres and at the end of the 25 year time period the mine site would become the property of the National Park Service. The 3.0 acre mine site that was specified in the law was intended to encompass the surface mining facilities existing on the South Rim at the time the law was approved.

The Cotter Corporation purchased the mine in 1967 and continued mining operations until April 1969, at which time all mining operations ceased. In February 1981, ownership of the mine was acquired by Republic Mining Enterprises of Redmond, WA. The mine has remained closed since 1969.

GEOLOGY

The Orphan Mine breccia pipe, similiar to many other pipes located in the Grand Canyon area, is a vertical, slightly elliptical pipe structure. The pipe is filled with sedimentary rock fragments, mainly Coconino Sandstone, which collapsed into a solution cavity formed in the Redwall Limestone. The pipe has a mean diameter of approximately 230 feet down through the Hermit Shale from the lower Coconino Sandstone in which the pipe outcrops. The pipe then flares out to a mean diameter of 400 to 500 feet in the upper Supai Formation. Indications are that the pipe bottoms near the middle of the Redwall Limestone.

The primary ore recovered from the Orphan Mine was uraninite, however, numerous secondary occurrences of uranium also exists in the pipe. In addition, the pipe contained possible economic levels of silver, copper, nickel, cobalt, lead, zinc, iron, and sulphur ores when recovered with the uranium.

SITE DESCRIPTION

The Orphan Mine is located a short distance north of the West Rim Drive between Maricopa and Hopi Points and very near the Powell Memorial which is to the northwest (Figure 1). The mine is not visible from the West Rim Drive, except the headframe can be seen occasionally from certain locations of the Drive. However, the mine and surface facilities are easily visible from the viewpoints at both Maricopa and Powell Points. Due to the close proximity of these two viewpoints, many Park visitors use the paved walkway between the two areas. However, the walkway in the area of the Orphan Mine surface facilities has been removed and fenced off. As a result, Park visitors must leave the walkway and walk around the fenced mine yard by following the fence around the eastern, southern, and western ends of the mine yard in order to reach the walkway again.

The 6 foot chain link fence delineates the 3.0 acre area reserved to the patented claim holder as required by Public Law 87-457. The northern extent of the reserved area lies beyond the edge of the South Rim, however, because of the rugged terrain below the rim the northern boundary was never fenced. Apparently, over the years as a result of curious Park visitors, a short section of the fence adjacent to the main gate leading into the mine yard has had its anchor bolts removed from one support post and, therefore, many Park visitors have entered onto the private property by stepping over the chain link fence.

The mine yard contained all of the support facilities for the mining operation. The headframe stands as the most prominent structure at the mine. The approximately 80 foot tall structure is located near the foundation of the original aerial tramway near the northeast corner of the fenced area. In addition to the headframe, the support facilities currently consists of 7 corrugated metal buildings, numerous foundations of previously standing buildings, water and septic tanks, ore storage pads, and various concrete and asphalt pads. The metal buildings had been used for such purposes as housing the mine hoist, the mine air compressor, maintenance shops, supplies and material storage, and offices. The mine yard appears to have been backfilled with some material from the mine in order to have a level working area.

A large water tank is located outside of the fenced area adjacent to the dirt road leading to the main gate from the West Rim Drive and a smaller secondary tank is located just off the edge of the rim near the northwest corner of the mine yard. The concrete septic tanks are located off the edge of the rim near the aerial tramway foundation. It also appears that two underground fuel storage tanks may still be located near the center of the mine yard.

After the mine was shutdown in April 1969, the Cotter Corporation removed all useable equipment and materials. The remaining equipment is either too large, such as the hoist drum and motors, to be easily removed or may be unuseable without extensive overhaul, such as the compressor. In addition, other miscellaneous equipment and materials still remain at the mine site today. These items, such as old mine ventilation ducts and electrical transformers, apparently have very little residual value.

The surface disturbance in the area of the breccia pipe is confined to an area that is smaller than the mine yard. The most prominent feature in this area is the open hole, approximately 30 feet in diameter and 200 to 300 feet in depth, that resulted when the surface subsided into the old underground mine workings. The adit is located on the western edge of the opening. The open hole appears to be getting larger at the surface. This is due to the fact that loose unconsolidated material that surrounds the hole on the down slope is being washed into the opening or material is sloughing off the slope of the opening into the hole at other times.

Other features located in the adit area include two small wooden bunkhouses (approximately 10 feet by 12 feet in size each) and the remains of a third wooden structure, the wooden foundation of the aerial tramway, a

small waste dump, mine workings, and a small amount of discarded mining equipment and debris.

The mine workings consists of a covered raise leading into the underground mine workings very near the open hole and three adits with one being adjacent to the covered raise. Two other adits are situated near the bunkhouses which are approximately 150 feet higher in elevation than the open hole. These two adits have been driven into the contact between the Coconino Sandstone and the Hermit Shale. The first of the two adit has had the bottom half bulkheaded off. As a result, a pool has been formed by the seepage of water through the sandstone. The remains of a piping system leading to the underground mine workings is apparent and the pool was probably a water source for the mine. The other adit, approximately 3 feet in height, is open and has a small amount of water seepage on the floor. No attempt was made to determine the length of either adit. A small diameter pipe, approximately 1.5 inches in size, protruding about 1 foot from the sandstone between the two adits was dripping water. A water sample was taken and analyzed to determine water quality. The results are discussed in Recommendation Number 6 and shown in Tables 2 and 3.

Finally, the structures that remain are the two intermediate support towers for the aerial tramway that had been put in place in order for the tramway to accommodate the terrain. The towers are constructed with wooden beams and are cantilevered out into the Canyon at locations where the terrain changes sharply. The upper of the two towers is located at the top of the Coconino Sandstone and the second tower is located approximately halfway down the Coconino Sandstone. The condition of these towers, which are anchored with concrete into the sandstone, could not be determined without a closer inspection. The steel tramway cable is still strung from just below the rim to the return tower at the adit area.

ABANDONMENT AND RECLAMATION RECOMMENDATIONS

As the deadline approaches for the National Park Service to receive control of the Orphan Mine property, thought must be given to what remedial action must be taken to minimize or mitigate any residual impacts from past mining activities. Due to the type of mineralization that was mined at the Orphan, the main impact to the local mine site area is the radiological contamination. In addition, the safety and visual impacts from the deteriorating condition of the mine facilities and structures must be taken into account. Therefore, proper abandonment and reclamation of the mine and mine yard is necessary in order to limit any hazardous situations to future Park visitors.

In order to develop recommendations for the proper abandonment and reclamation of the Orphan Mine site, representatives of the Bureau of Land Management with experience in mining and the reclamation of uranium mines, have inspected the area on a number of occasions during the past year and a half. The inspections were conducted for the purpose of gathering information on the current condition of the mine and to inventory equipment

and facilities. The inspections also included radiological surveys of both the mine yard area and the lower adit area.

Based on the information gathered, the following recommendations are made in order to properly abandon and reclaim the Orphan Mine site:

1. **HEADFRAME AND HOIST.** If the decision is made by Park Service officials to remove the headframe, it may be possible to offer the headframe and related hoisting equipment to a mining company, free of charge, on the condition that the mining company dismantles and removes the headframe and hoist at its own expense and within a specific time. This recommendation is made because it is felt by the BLM that the headframe and hoist has definite salvage value even during a period where the mining economy is depressed which the country is experiencing now. Any implementation of this recommendation should be done under close Park supervision to ensure timely removal.

However, if this recommendation proves to be impractical or unfeasible, it is recommended that the headframe be either dismantled and properly disposed of by burial, disposed of as scrap metal, or retained by the Park for future internal use as structural steel. Before the second and third options can be considered for implementation, the structure will need to be checked for any radiological contamination.

2. **STRUCTURES.** All corrugated metal structures should be dismantled and properly disposed of at an authorized burial site. Here again, in order to minimize the cost of removal to the Park Service, it may be possible to offer the corrugated metal to a scrap dealer if he would dismantle and remove the material at his own expense and if the material is not contaminated. The wooden frames, a concrete block wall, and a small concrete block addition to one of the buildings will have no salvage value and, therefore, will still have to be disposed of by burial.

Other structures, such as the water tanks and septic tanks, should be dismantled and properly disposed of at an authorized burial site. Miscellaneous structures, such as the fence and power poles, should also be dismantled and properly disposed of. These miscellaneous structures may have enough salvage value to entice a scrap dealer to remove the structures or may be useful to the Park for internal use. Miscellaneous structures and equipment located just off the edge of the rim should also be removed and properly disposed of by burial. The fence should remain in place until the site work recommended in Number 4 is ready to begin.

The structures, including the bunkhouses and the return tramway tower, located in the adit area have no salvage value because of their remote location and should be dismantled and disposed of by depositing into the open subsidence hole. This recommendation would be more cost effective than transferring the material by

helicopter to the South Rim before disposing the material at a burial site. There would be no impact to the Park from this recommendation because of the depth of the open subsidence hole.

3. **EQUIPMENT AND MATERIAL.** Equipment, other than the hoist discussed under Recommendation Number 1, should be removed and properly buried. One possible exception would be the compressor which may have some residual salvage value. This particular piece of equipment could also be offered, as part of any agreement for removing the headframe, as an additional incentive. No other equipment appears to have any salvage value.

However, because of the approximate age of the electrical transformers identified earlier, it is recommended that they be checked to determine if any of them may contain the hazardous chemical PCB (polychlorinated biphenyl) which was used as an electrical insulator. If underground fuel tanks still exist within the mine yard, their location should be accurately determined prior to any work commencing under Recommendation Number 4. The tanks will need to be uncovered and removed to a proper disposal site after verifying that the tanks no longer contain fuel. Other than these special precautions, the disposing of all other equipment should pose no special handling problems.

Mine related materials, such as the ventilation ducts and water pipes, have no salvage value and should be removed and properly buried. The bulk of the miscellaneous material consists of trash and debris and should have no special handling problems or precautions to be aware of.

The equipment and material, including debris, located in and around the lower adit area should be disposed of by depositing into the open subsidence hole which will be more cost effective than the use of a helicopter to remove the items.

4. **SHAFT AND CONTAMINATED MATERIALS.** Based upon the BLM radiological survey, the area in and around the mine yard is emitting low levels of radiation. Two explanations of the source of the low level radiation would be that material from the mine was used as fill when the mine yardsite was being prepared and/or the random scattering of uranium ore by men and equipment during the active mining periods. In addition, it appears that low level radioactive material was transported by wind and water action to the Park lands adjacent to the fenced mine yard. Please refer to Figure 4 which shows the area, approximately 5.6 acres in size, where contamination has occurred. Figure 5 is a sketch copy of the mine yard area which shows the readings taken during the radiological survey.

In order to minimize the exposure from this hazard, it is recommended that the area showing radiation levels greater than the amount specified by Part 20 of Title 10 of the Code of Federal

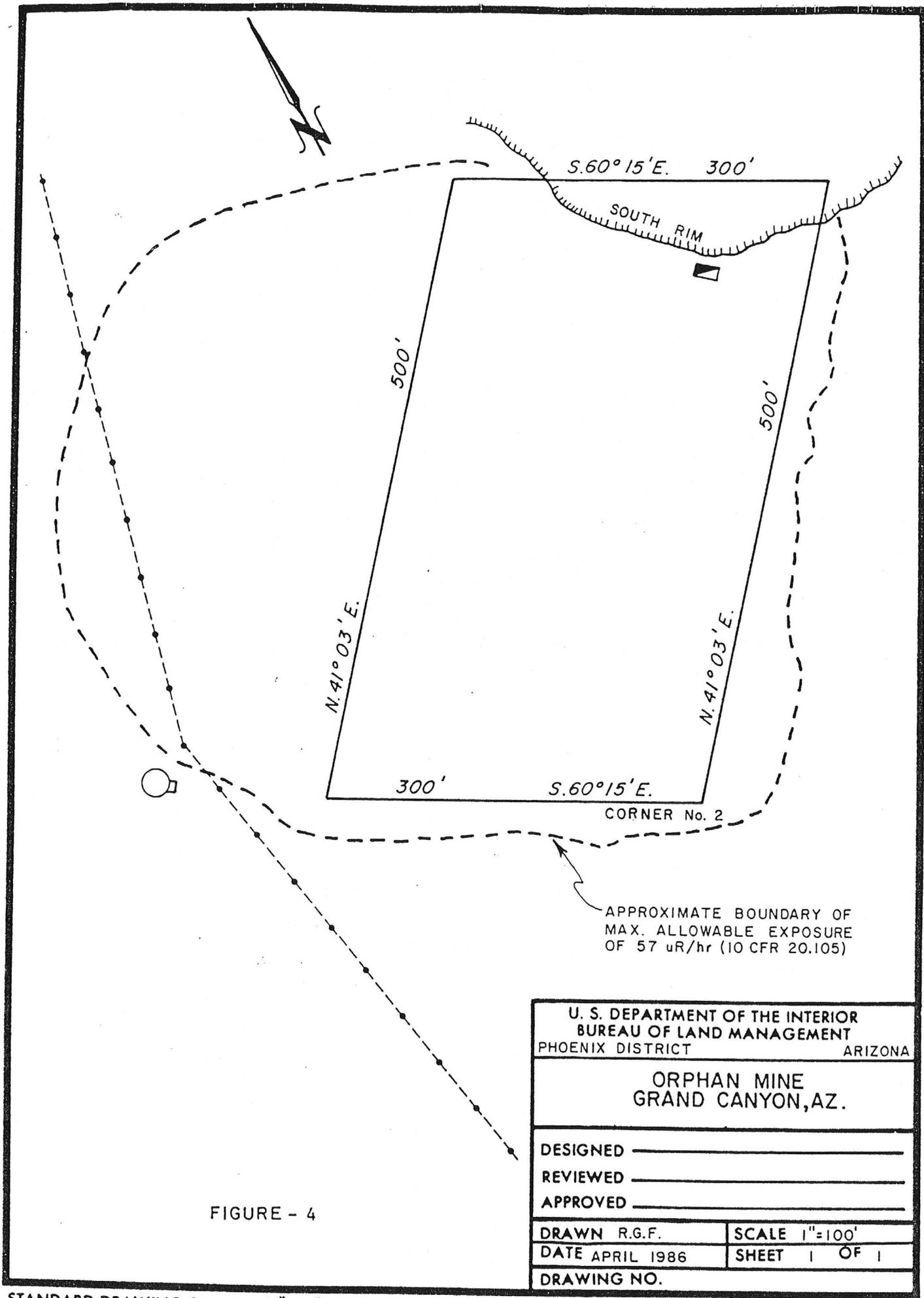


FIGURE - 4

U. S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT PHOENIX DISTRICT		ARIZONA
ORPHAN MINE GRAND CANYON, AZ.		
DESIGNED	_____	
REVIEWED	_____	
APPROVED	_____	
DRAWN R.G.F.	SCALE 1"=100'	
DATE APRIL 1986	SHEET 1	OF 1
DRAWING NO.		

Regulations, 10 CFR 20.105(a), be removed and properly disposed of by burial. The limit of 0.5 rem per year exposure or 57 microrem per hour (57 uR/hr) contained in the above cited regulation and recommended in this report is the limit allowed by the Nuclear Regulatory Commission for areas where unrestricted uses are anticipated. Therefore, the achieving of this permissible radiation level or a lower level would be a reasonable expectation for the Orphan Mine site in light of the easy access into the mine yard area by Park visitors.

The BLM radiological survey conducted of the mine yard area consisted of parallel traverses, based upon Brunton Compass and pacing of the distances between meter reading points, of the mine yard at approximately 25 foot intervals. The readings were gathered using an Eberline PRM-7 Mirco R meter and readings were taken at waist height. The following table contains selected sample readings taken during the survey.

TABLE 1*

Location	Micro R/hr.
Eastern ore bin at headframe	1100
Clearing west of fence	800
Northern end of concrete wall along eastern fence	380
East end of stacked ventilation ducts	240
Approx. 25 feet east of east fence	115
Open subsidence area	1100
Adit next to open subsidence area	3200
West collar of shaft	650

*The readings of the mine yard area are similiar to the readings that were obtained by a survey conducted by National Park Service. See Fiano, J., 1982.

It is recommended that the contaminated material with the highest radiation readings in and around the fenced mine yard be deposited down into the mine shaft which still contains radioactive materials. The use of the mine shaft would minimize any hazards associated with transporting the material to a remote burial site. The contaminated materials will consist of soil and concrete. However, based on a preliminary estimate which assumes no interference from the shaft support structure or from any mine support equipment such as air and water lines, the total volume of contaminated material will exceed the volume of the mine shaft by 100 to 200%. Therefore, the material with lower radiation readings will either have to be transported to a remote burial site or buried on site. Contaminated material located off the edge of the rim should also be recovered but may be difficult to reach with

mechanical equipment and may have to be left in place if the volume is small or the amount of disturbance outweighs the benefits.

The work of gathering the contaminated materials would be accomplished by a combined dozer and frontend loader operation. It is recommended that dust control measures (water spray) be used during the removal of contaminated materials, so that additional radioactive material is not transported by the wind to adjacent Park lands. In order to minimize the amount of uncontaminated material that is removed with the contaminated material, it is recommended that radiation readings or soil samples be taken as the work progresses. Due to the shallow depth of the contaminated material in some locations, the monitoring of the work must be done on a continuous basis and not on an intermittent basis. Therefore, properly trained personnel with the necessary radiation and/or soil sampling equipment should be onsite at all times during the removal operation.

Once the shaft has been filled to within six feet of the surface with contaminated material, the shaft should be sealed with a 4 foot concrete cap and then 2 feet of top soil. The concrete cap should be so designed that it is anchored into the sides of the shaft so that future settling of the contaminated material will not cause the cap to settle. In addition to isolating the contaminated material, the capping of the shaft will prevent further escape of radon gas which is also a health hazard.

After the mine yard site has had all of the contaminated materials removed, it is recommended that the site be backfilled with topsoil and contoured into the natural terrain. A suitable vegetative cover should be established in order to minimize erosion of the site.

5. **SUBSIDENCE AREA.** Due to the remoteness and size of the open hole that was created when the surface subsided into the old underground mine workings, the only practical recommendation to reclaim the area would be to construct a heavy duty chain link fence so that wildlife and hikers would be kept a safe distance from the subsidence hole. The location of the fence must take into account that the top of the hole has not yet completely stabilized. Danger and radiation warning signs should be posted on the fence to warn Park visitors who may venture into the area of the dangerous situation.
6. **ADITS AND RAISES.** All adits and raises should be sealed to prevent entry into the underground mine workings. Sealing these mine entries can be accomplished by either the construction of a concrete seal or the use of an explosive charge to blast in the sides of the entry. This recommendation includes the adit at the open subsidence hole even though it will be located within the fenced off area identified in Recommendation Number 5. The sealing of this adit is necessary because it would prevent someone from

climbing over the fence and entering the underground mine workings.

The adit that has been partially bulkheaded off should be blasted shut in order to prevent the buildup of water in the adit. Since the water is naturally occurring in the Coconino Sandstone, the destruction of the bulkhead will allow the water to seep down and dissipate over the naturally occurring outslope of the Hermit Shale at that location. The quality of the water is within acceptable standards except for the detectable levels of dissolved uranium, radium-26, and radon-222. Results of the water sample taken from the pool are shown in Tables 2 and 3, however, additional sampling of the water will be needed to determine any health impacts to consumption by humans and wildlife. It may be unwise to completely seal off the adit because of the possibility of the seal failing at a future date.

7. TRAMWAY. Due to the type of construction materials used on the tramway towers, natural deterioration will eventually cause the towers to collapse. Access to the intermediate tramway towers will be more difficult than the lower adit area. For this reason, it will be cost effective to leave the intermediate towers in place.

However, the decision can be made to remove the tramway towers. This option will require extensive helicopter support and a large labor force to dismantle and remove the intermediate tramway towers and to gather up the cable which will probably have to be cut into shorter lengths in order to be handled by the helicopter. The structural material of the towers, after dismantling, and the cable may either be airlifted to the South Rim for disposal at a remote site or to the lower adit area for disposal in the open subsidence hole. The final method of disposal can only be determined after an evaluation of the ability of the helicopter to safely deposit the material directly into the open subsidence hole or adjacent to the hole. Such factors as wind conditions or steepness of the terrain will have to be taken into account.

The concrete foundations of the tramway towers should be left in place because of the effort that will be needed and the disturbance that may be caused in order to remove the imbedded concrete. These foundations would have no impact to the Park if they were left in place.

CONCLUSION

The abandonment and reclamation of the Orphan Mine site should be implemented by the National Park Service in order to minimize the residual hazards to Park visitors from the mining operation. However, the reclamation of the mine need not be the highest priority of the Park Service because of the short exposure time experienced by Park visitors. The reclamation recommendations should be implemented as the Park Service budget and resources will allow without disrupting the normal operation of the Park.

Personnel from the Bureau of Land Management will be available to discuss any aspect of this report prior to the finalization of the Orphan Mine reclamation plan by the National Park Service.



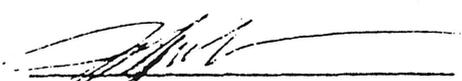
PAGE 1
RECEIVED: 05/31/85

CEP, Inc. REPORT
06/14/85 16:59:12

LAB # 85-05-443

REPORT Bureau of Land Management
TO 2015 W. Deer Valley Road
Phoenix, AZ 85027

PREPARED Controls for Environmental
BY Pollution, Inc.
1925 Rosina Street
Santa Fe, NM 87502


CERTIFIED BY

ATTEN Moon Hom

ATTEN
PHONE (505) 982-9841

CONTACT GAIL

CLIENT BUREAU LAND SAMPLES 1
COMPANY Bureau of Land Management
FACILITY Phoenix District Office

WORK ID Environmental
TAKEN
TRANS Mail
TYPE Water
P.O. # A-17643-MC
INVOICE under separate cover

SAMPLE IDENTIFICATION

CEP, Inc. TEST CODES and NAMES used on this report

01 Orphan #1

FU 1 Total Uranium
RA226W Radium-226
RADON1 Radon-222



PAGE 2

REPORT OF ANALYSIS

LAB # 85-05-443

SAMPLE IDENTIFICATION

Orphan #1

DATE COLLECTED

not specified

TYPE OF ANALYSIS

Total Uranium
Radium-226
Radon-222

mq/liter

0.620
17.9±2.0 (pCi/liter)
1.19±0.40(pCi/liter)

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- Tetreault, G. "Report on the Orphan Mine--Grand Canyon National Park, Arizona." U. S. Bureau of Land Management, Albuquerque, NM. April 1986.

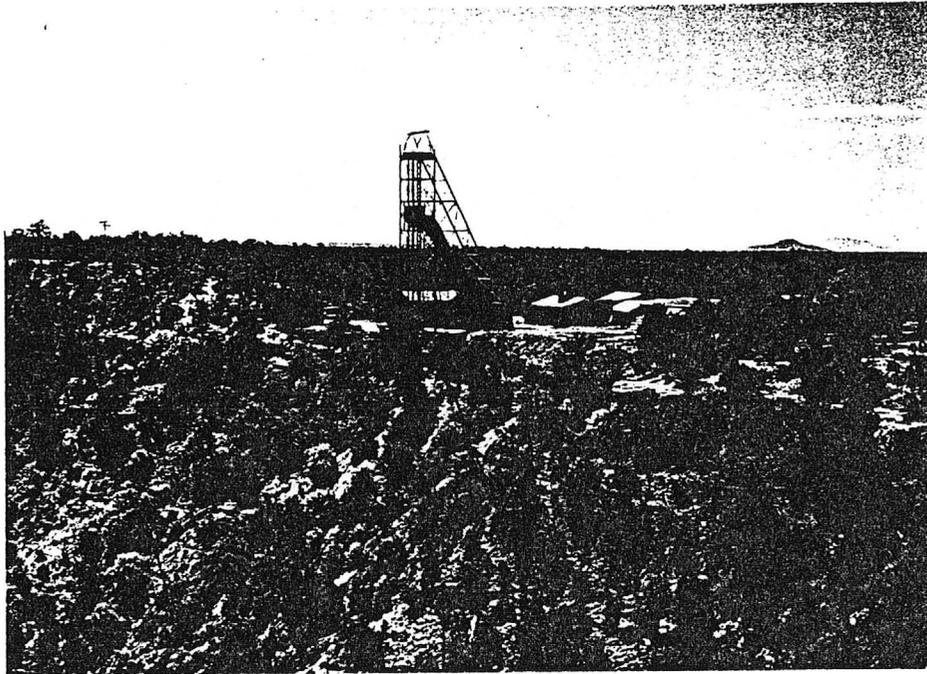
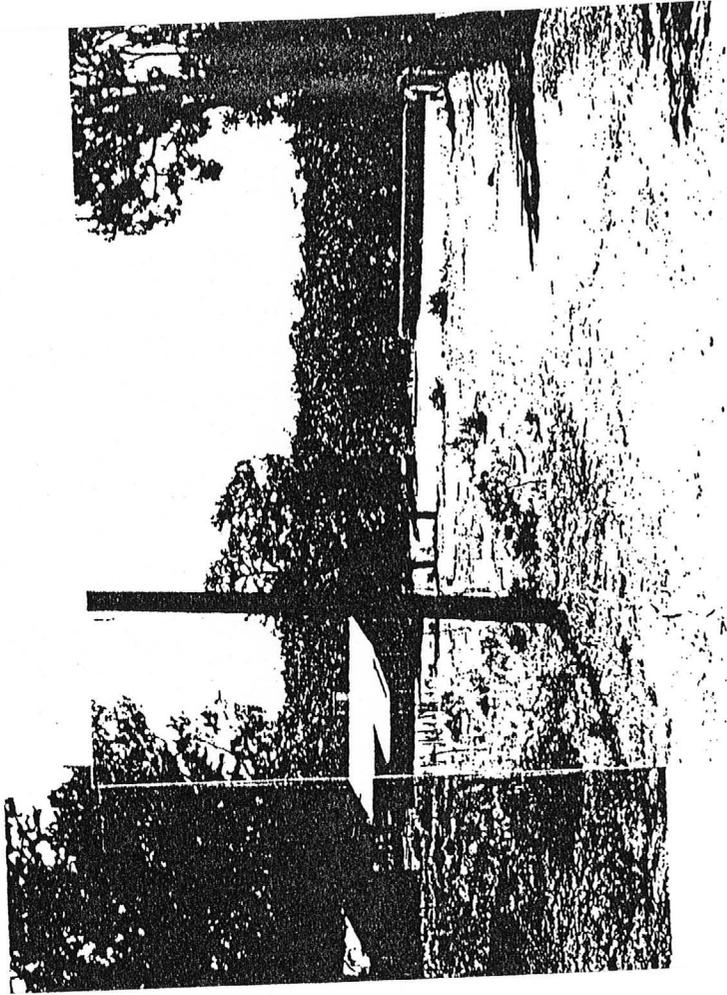
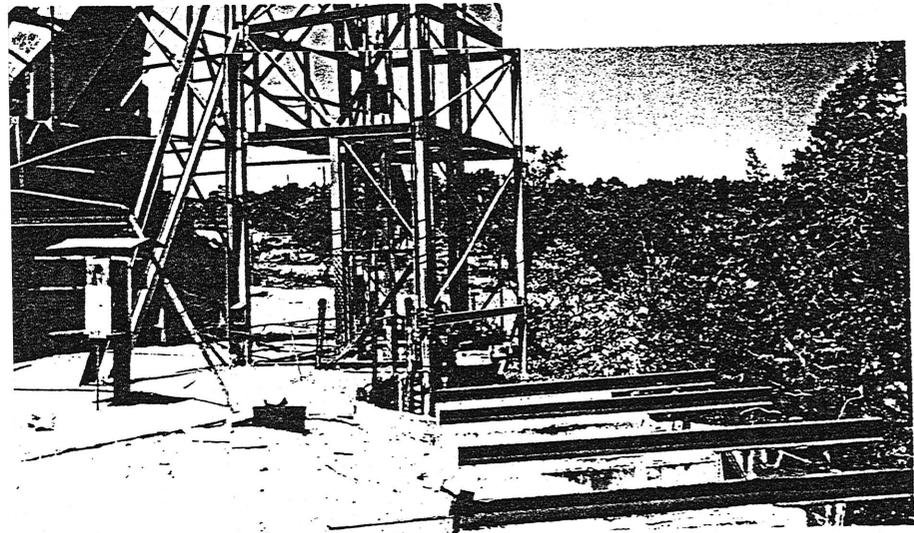


PHOTO #1: The view of the Orphan Mine facilities located on the South Rim of the Grand Canyon. The photo is taken from the Powell Memorial.



phan Mine facilities located on the South Rim.
ken from the mine yard gate and is looking ro



View of the Orphan Mine facilities on the South Rim.
Taken, looking to the south, from the foundation of
tramway.

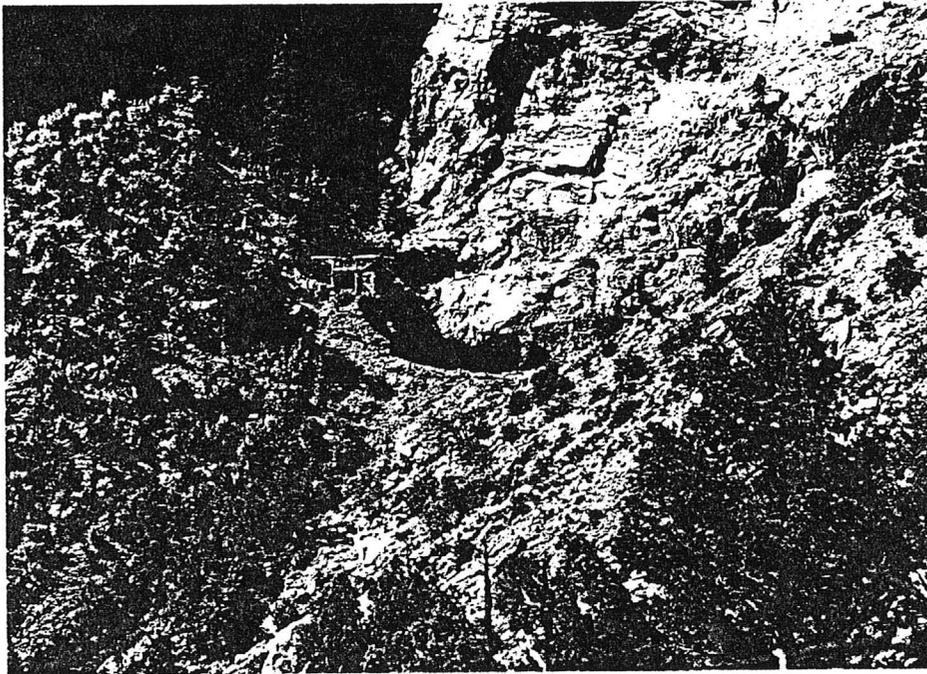


PHOTO #4: This photo show the lower adit area which includes the open subsidence hole and the lower aerial tramway tower.

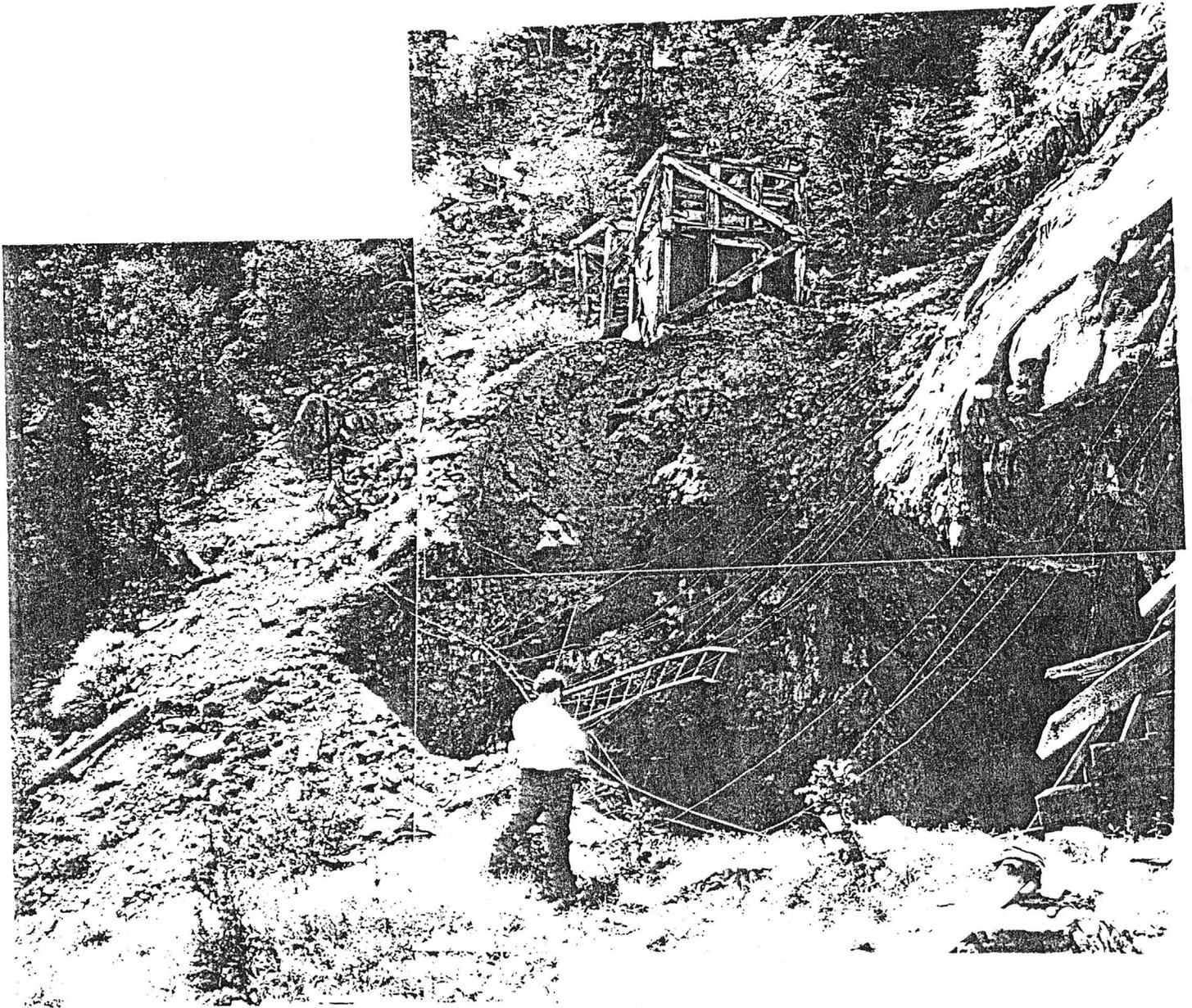


PHOTO #5: This photo is a closeup view of the open subsidence hole and low aerial tramway tower shown in Photo #4. The cables and wooden planks were an apparent attempt to isolate the open hole from men and equipment in the area.

5-14-85

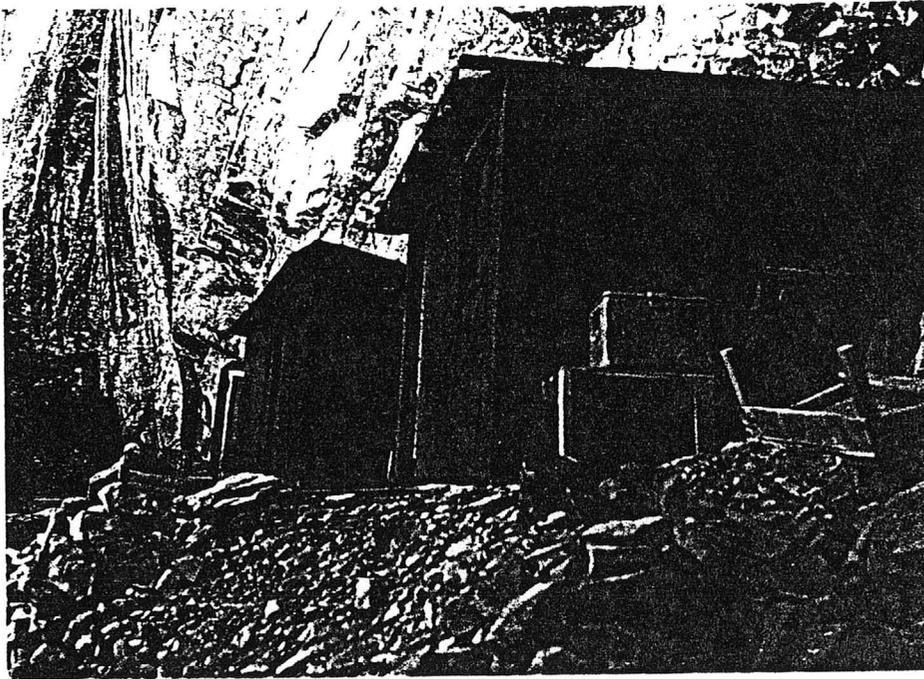


PHOTO #6: A view of the bunkhouses located at the lower adit area of the Orphan Mine. The ledge that these structures sit on is located at the left of top center of Photo #4.

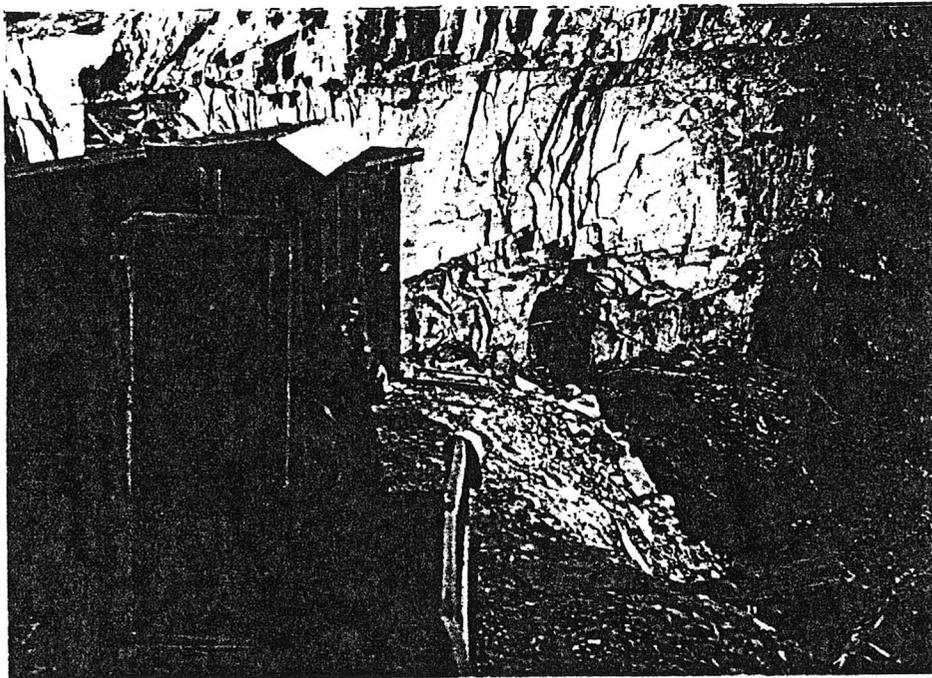


PHOTO #7: This photo is looking back to the area where Photo #6 was taken. Two adits, with the near one partially bulkheaded, are seen in this photo.

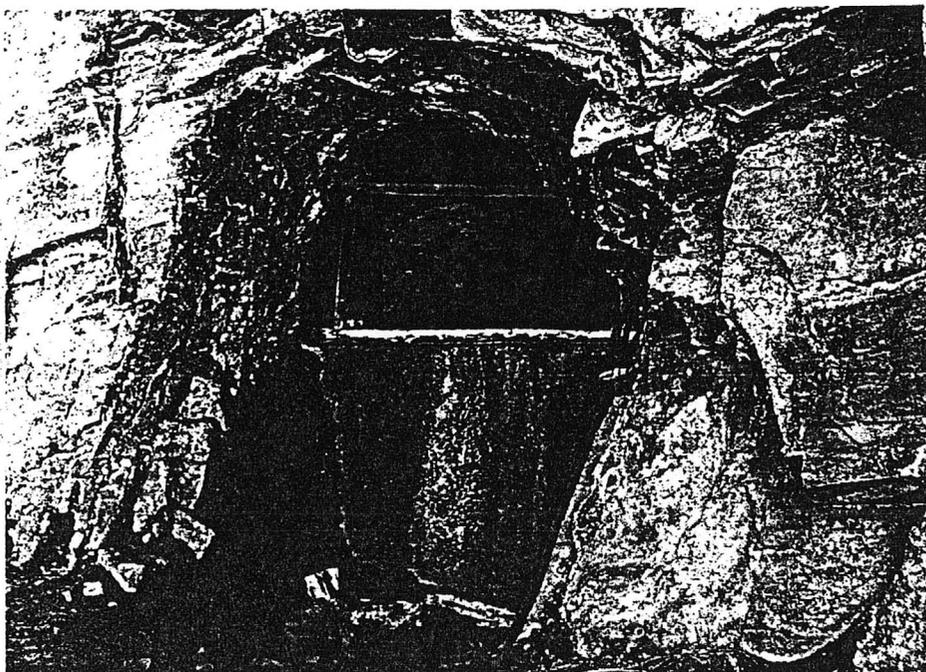


PHOTO #8: A closer view of the partially bulkheaded adit seen in Photo #7.

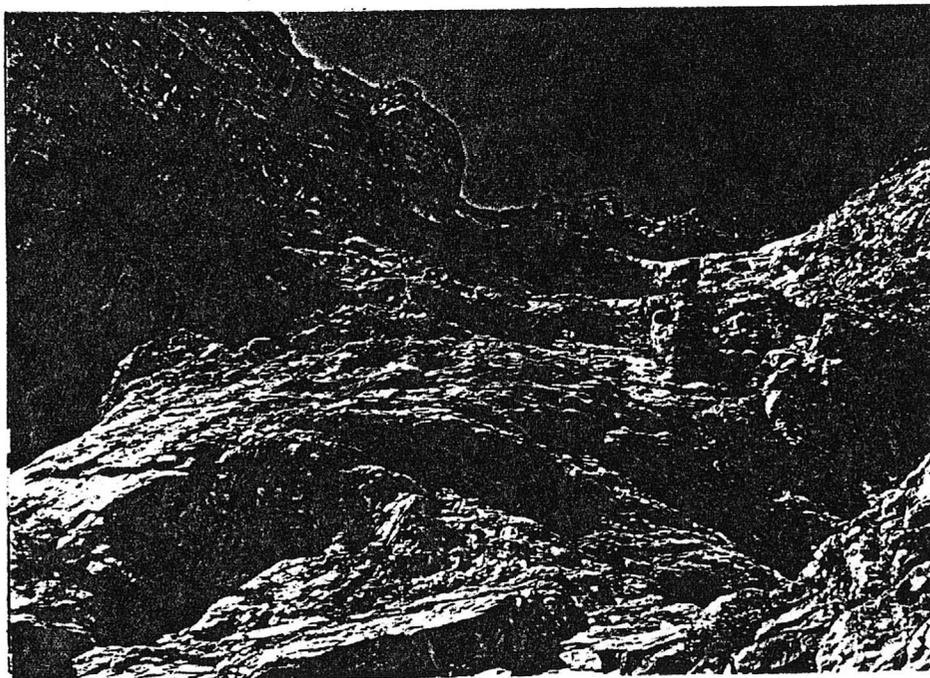


PHOTO #9: A view of the two intermediate aerial tramway towers from the lower adit area.



United States Department of the Interior



GEOLOGICAL SURVEY
BOX 25046 M.S. 939
DENVER FEDERAL CENTER
DENVER, COLORADO 80225

IN REPLY REFER TO:

Branch of Sedimentary Processes

July 27, 1994

Mr. Thomas D. Mulhern
National Park Service
Western Regional Office
Park Historic Preservation
600 Harrison Street, Suite 600
San Francisco, California 94107

Dear Mr. Mulhern:

Approximately a year ago copies of a "draft National Register of Historic Places nomination form for the Orphan Lode Mine in Grand Canyon National Park, Arizona" were sent to Mr. William Chenoweth, Grand Junction, CO and to myself. Mr. Chenoweth sent you a letter on August 31, 1993 making some review suggestions, as well as some very significant input for why the Orphan should be made a National Historic Place. To date neither of us has heard anything concerning the status of the mine. Mr. Chenoweth was concerned as to whether you had received his letter.

We both want to state that we think that Mr. Unrau did an excellent job of researching the history, although there are some errors. Mr. Chenoweth pointed out several and I have attached a sheet showing some. I assume that someone caught all of the spelling errors of the mineral names--corrections attached in case this has not been done. We were told that the report would be sent to the Arizona State Historic Preservation Office. Has it?

Our major concern is that we do not think that Mr. Unrau presented a compelling case (see item #2 on attached correction sheet) for making this a historic site. Several of the four most important points were not brought out in his document that we believe qualify the Orphan mine for a National Historic Site: (1) The founder of the mine itself was a very colorful historic figure. Daniel Hogan was not only one of Teddy Roosevelt's "Rough Riders", but he was also a sheriff of Coconino County in the 19th century. (2) Hogan's original adits that produced copper are still present along the Coconino Sandstone-Hermit Shale contact. These adits are over 100 years old. (3) The Orphan Lode was a world class uranium deposit and represents a deposit type (solution-collapse breccia) that became the geologic model in the search for other similar ore-bearing pipes in the Canyon region and elsewhere in the world. This deposit type contains the highest grade uranium that we have in the United States. (4) The Orphan was the only uranium mine to ever produce within a national park.

We believe strongly that the public should not be denied the opportunity to visually appreciate our mining heritage. Whether or not the National Park deems mining to be bad is irrelevant--it is part of this countries heritage and should

not be swept from the public's sight. Mr. Chenoweth and I believe that removal of the headframe would destroy any visual representation of mining in this region to the public. It does little good to provide the public with interpretive pamphlets if there is no authentic visual representation to leave a lasting memory. There is nothing that represents mining more than a headframe--see most art work from mining districts throughout the western U.S.

Mr. Chenoweth and I would like to know the current status of the Orphan Mine as a National Historic Site and Mr. Unrau's report. We look forward to hearing from you.

Sincerely,



Karen J. Wenrich
Geologist

Suggested Corrections for Orphan Mine
National Register of Historic Places Nomination Form

1. Section 7, p. 5--2nd paragraph from the bottom starts "A second edit..." should be "A second ~~edit~~".
2. Section 7, p. 7--3rd paragraph, last sentence. "Most of these remnants can be best characterized as mine-related ~~junk~~". This entire sentence should be deleted--it demonstrates prejudice on the part of the Park Service against the preservation of the mine as a historic site, and perhaps sheds light on why Mr. Unrau didn't present very compelling arguments for the preservation of the mine.
3. Section 8, p. 16--1st paragraph, 1st sentence. "...of Arthur R. Still, a consulting USGS geologist..." I don't know what a USGS consulting geologist is, but it is illegal for any USGS geologist to consult! I suggest strongly that you take the words USGS out of there. In addition, there is no such person listed in the USGS directory.
4. Section 8, p. 16--last paragraph, 3rd line. "...Mining geologist form Tempe, Arizona" should read "...Mining geologist ~~from~~ Tempe, Arizona".
5. Section 8, p. 29--last paragraph, 4th line. The subscript "a" in CaCO_3 should be a regular lower case "a".
6. Section 8, p. 31--2nd paragraph, 4th line. The sentence "The Tuba City mill was modified with the installation of a carbonate leaching circuit and a sulfide flotation cell to recover copper and treat high lime ores, which the lime Orphan was increasingly producing" doesn't make sense? What is "the lime Orphan"?
7. Section 8, p. 36--2nd paragraph, 1st line. "Data on the content of other minerals...." Those aren't minerals that he is talking about they are elements. The sentence should read "Data on the content of other elements". Or the term "metals" would be appropriate.
8. Section 8, p. 36--last paragraph, 5th line. "Furthermore, the deposit combines characteristics of sedimentary Colorado Plateau uranium deposits with structural features suggestive of hydrothermal veins". This is geologically totally wrong! There are no veins and the deposit is not "hydrothermal" in nature. It is solution collapse with temperatures < 170°C--this is well documented in all of the current geological literature--in fact, if one looks in either of the two references cited at the bottom of that page one can find this information.
9. Section 8, p. 36--footnote #59. the name "Sutphia" should be ~~"Sutphin"~~.
10. Section 8, p. 37-38--corrected copies of pages attached. This is probably the greatest conglomeration of misspelled mineral names I have ever seen.
11. Section 8, p. 39--1st paragraph, 4th line. "minor amounts of nickel and

cobalt, and low vanadium content." This is a strange way to describe a mine that has produced uranium, copper, vanadium, and silver, but not nickel and cobalt. The nickel and cobalt contents are much more minor from a stand point of potential economics than are the other 4 elements.

12. Section 8, p. 39. "The structure and mineralogy of the Orphan Mine seem to support the hydrothermal theory of origin..." Such a statement indicates that the Park Service is not reading any of the current literature (much of which I personally supplied Mr. Unrau with). That statement is from literature that is 35 years out of date. New data and mapping by multitudes of geologists have indicated otherwise. I suggest strongly that you update that statement. In fact, the solution-collapse origin of the breccia pipes is one of the features that makes this deposit type so unique. Once again it appears that Mr. Unrau is trying to downplay the uniqueness of this deposit.
13. Section 9, p. 3. This is a very strange list of references. I have never seen a reference list before that doesn't show the authors of the papers. For instance the 6th reference down (Open-File Report 89-550) on the list is by H.B. Sutphin and K.J. Wenrich, but no where are there names present in the reference citation.

United States Department of the Interior
National Park Service

National Register of Historic Places
Continuation Sheet

Section number 8 Page 37

Elements and Minerals Found in the Orphan Pipe

I. Metallic Minerals & Elements:

Metal	Identified by	Mineral(s)	Primary	Secondary
Uranium	AEC	Uraninite-Pitchblende	X	X
	AEC	Coffinite	X	
	AEC	→ Tobernite, Meta-tobernite		X
	AEC	→ Zellerite, Meta-zellerite		X
	AEC	Gummite		X
	→ McLeod (1987)	Hydrous Uranium Sulphate (?)		X
	Mason (1960)	Uranospinite		X
		Uranopilite (?)		X
		Zippeite (?)		X
		Johannite (?)		X
		Curite (?)		X
		Uranophane		X
		→ Schrockingerite Schrockingerite		X
Antimony		→ Tetrahedrite	X	
		→ Stibnite	X	
Arsenic	Mason	Bindheimite (?)		X
	→	Tennantite	X	
Copper		Arsenopyrite	X	
		Uranospinite		X
		Orpiment, Realgar (?)	X	X
		Tennantite, Tetrahedrite	X	
		Bornite, Chalcopyrite	X	
		Chalcocite	X	X
		Digenite (?)	X	
	McLeod	Covellite	X (?)	X
Gold		Malachite		X
		Azurite, Brochantite		X
		Cuprite	X	
		Native Copper		X
		Native (?)	X	
		Pyrite	X	
		Hematite, Siderite	X	
Iron		Ankerite, Jarosite		X
		Melanterite, Goethite		X
		Limonite, Marcasite		X
		Galena	X	
		Wulfenite		X
Lead		Anglesite		X
		Bindheimite (?)		X
		Dolomite	X	
Magnesium	→	Rhodochrosite	X	
	→	Pyrolusite (?)		X
Manganese		Molybdenite	X	
		Ilsemanite		X
		Wulfenite		X
Molybdenum	McLeod	Siegenite	X	
	AEC	Nickel-Skutterudite (?)	X	
	McLeod	Bravante (?)	X	

United States Department of the Interior
National Park Service

National Register of Historic Places
Continuation Sheet

Section number 8 Page 38

	Mason	Millerite (?)		X
		Zaratite (?)		X
		Annabergite (?)		X
		Erythrite		X
Mercury		Cinnabar	X	
		Metacinnabar (?)		
Silver		Proustite	X	
Selenium		(Unknown)		
Vanadium		Hewettite		X
Zinc		Sphalerite	X	
		Marmatitic Sphalerite	X	
		Smithsonite		X

II. Elements Indicated by Spectrographic Analysis.

^a Minerals Unknown:

- ~~C~~admium
- Columbium (?)
- Gallium
- Germanium
- Tantalum
- Tin
- Titanium
- Yttrium

III. Non-Metallic Epigenetic Minerals:

- Barite, ~~bar~~ ^{bary}calcite *barytoalcite*
- Calcite
- Dolomite
- Aragonite
- Siderite
- AEC Andesine, Labradorite
- Quartz (overgrowth, normal in sediments)
- Hamilton Illite
- Hamilton Alunite
- Mason Allophane
- Barrington Kaolin (Kaolinite)
- Barrington Sericite
- Gypsum
- Rare Metals Carbon

NOTES:

- (1) (?) indicates a tentative identification.
- (2) Identification credited where possible.

Kofford, "The Orphan Mine, "p. 194."



IN REPLY REFER TO:

United States Department of the Interior

NATIONAL PARK SERVICE
GRAND CANYON NATIONAL PARK
P.O. BOX 129
GRAND CANYON, ARIZONA 86023-0129

K14 (GRCA)

OCT 24 1985

Mr. William L. Chenwoeth
707 Brassie Drive
Grand Junction, Colorado 81506

Dear Mr. Chenwoeth:

We still have the two core samples extracted from the Orphan Mine stored in our museum collection. Please see the enclosed catalogue card photocopies for these two specimens.

Our museum collection is available for researchers Monday through Friday, 8-12 and 1-5 except on holidays. You are more than welcome to visit our collection during these times to conduct your research. The museum staff will also be available to answer questions prior to your visit. Please call (602) 638-7769 if you have questions.

We look forward to meeting you and setting up a research day. Thank you for planning ahead and letting our staff know of your intent.

Sincerely,

John C. O'Brien
Chief, Division of Visitor Services and Interpretation

Enclosures 2

CLASSIFICATION ROCK SEDIMENTARY CORE- SUPAI FM.	U. S. DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE	CATALOGUE NO.
		18755
	Grand Canyon National Park (AREA)	ACCESSION NO.
	MUSEUM CATALOGUE RECORD	1395

OBJECT
Diamond Drill Core - Supai Fm.

LOCALITY
Orphan Mine, South Rim of Grand Canyon National Park, Arizona.

DESCRIPTION
Ca. 36 ft. of one inch core from hole drilled by Mining Company Cotter Corp. Drilled horizontally at 400 ft. level; (400 ft. below adit level). Drilled directly east 750 ft.

DATE RECEIVED 6/68	RECEIVED FROM (Name and address) Cotter Corp. Grand Canyon, Arizona	HOW ACQUIRED Donation
VALUE	PRESENT LOCATION 144.01	DETERMINED BY
CATALOGUER Jean L. Beal, Museum Technician	DATE 7/2/68	MANNER OF DISPOSAL
		DATE

FORM 10-254 (May 1957) * U. S. GOVERNMENT PRINTING OFFICE : 1961 O - 609445

CLASSIFICATION Rock Sedimentary Core	U. S. DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE	CATALOGUE NO.
		17593
	Grand Canyon National Park (AREA)	ACCESSION NO.
	MUSEUM CATALOGUE RECORD	1183

OBJECT
Diamond Drill Core

LOCALITY
Orphan Mine. South rim of the Grand Canyon National Park, Arizona.

DESCRIPTION
C 400 feet of 3/4 inch core from hole p-13 drilled by the mining company to test the amount of collapse in ~~the~~ which the pitchblend is found.
Drill hole collared at the 550' level of the mine (440' below the top of the Supai formation)
Core footage 1481'--1540', 1598-1914' t. D.
Reaches top of Bright Angel Shale 1515' and top of Tapeats sandstone 1854.4'. See in catalog file.

DATE RECEIVED 11 Sept 1964	RECEIVED FROM (Name and address) Western Equities Inc., Grand Canyon, Arizona	HOW ACQUIRED Donation
VALUE	PRESENT LOCATION 144.02	DETERMINED BY
CATALOGUER N. G. Messinger, Museum Curator	DATE 17 Sept 64	MANNER OF DISPOSAL
		DATE

FORM 10-254 (May 1957) U. S. GOVERNMENT PRINTING OFFICE : 1957 O - 6-132110

UNITED STATES GEOLOGICAL SURVEY DEPARTMENT OF THE INTERIOR

ELECTRICAL CHARACTER OF COLLAPSE BRECCIA PIPES
ON THE COCONINO PLATEAU, NORTHERN ARIZONA

by

Vincent J. Flanigan, Pam Mohr, Charles Tippens, and Michael Senterfit

OPEN-FILE REPORT 86-521

This report is preliminary and has not been reviewed for conformity to
United States Geological Survey editorial style and nomenclature.

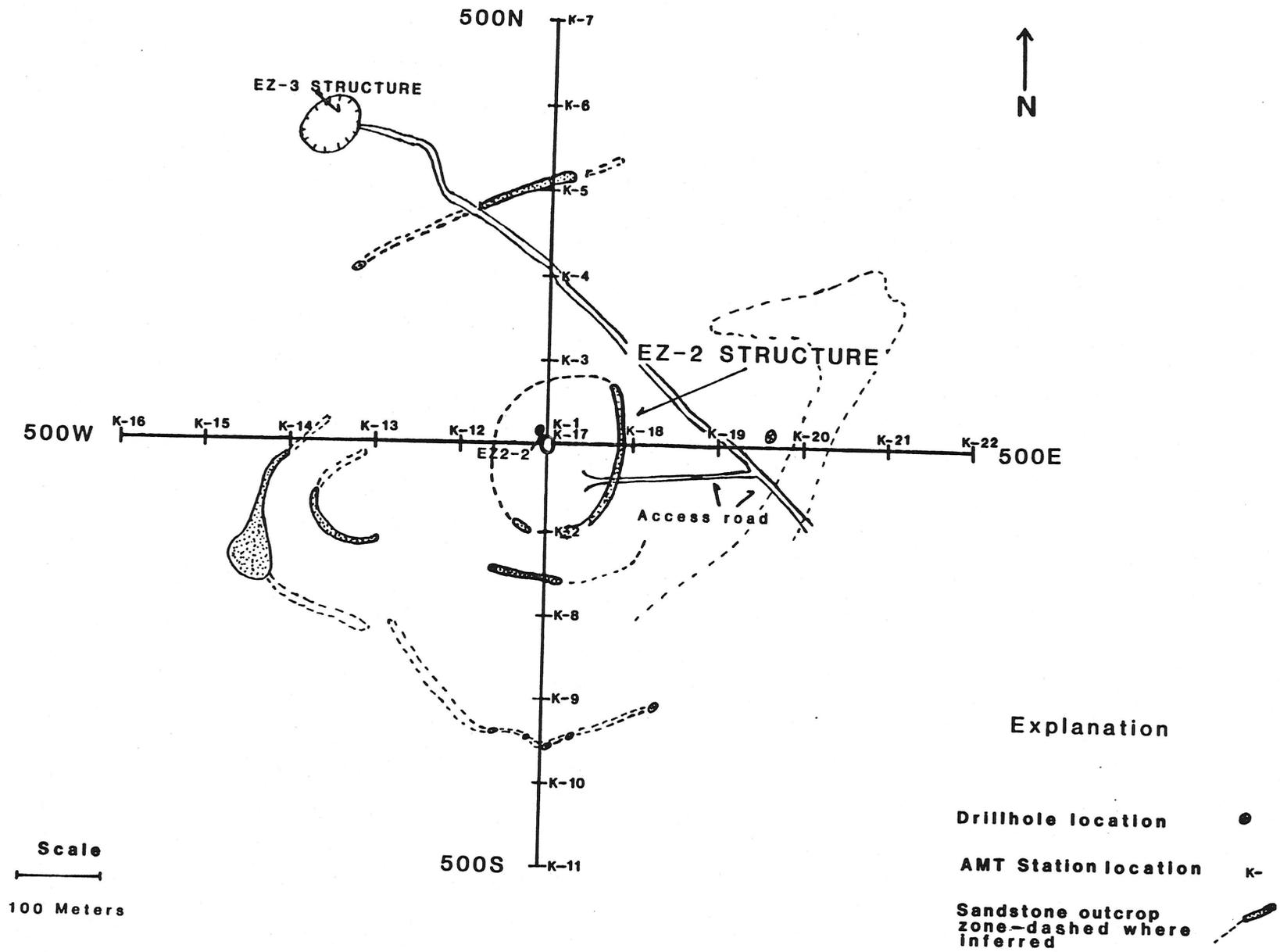


Figure 3 AMT sounding location at the EZ-2 breccia pipe, northern Arizona.

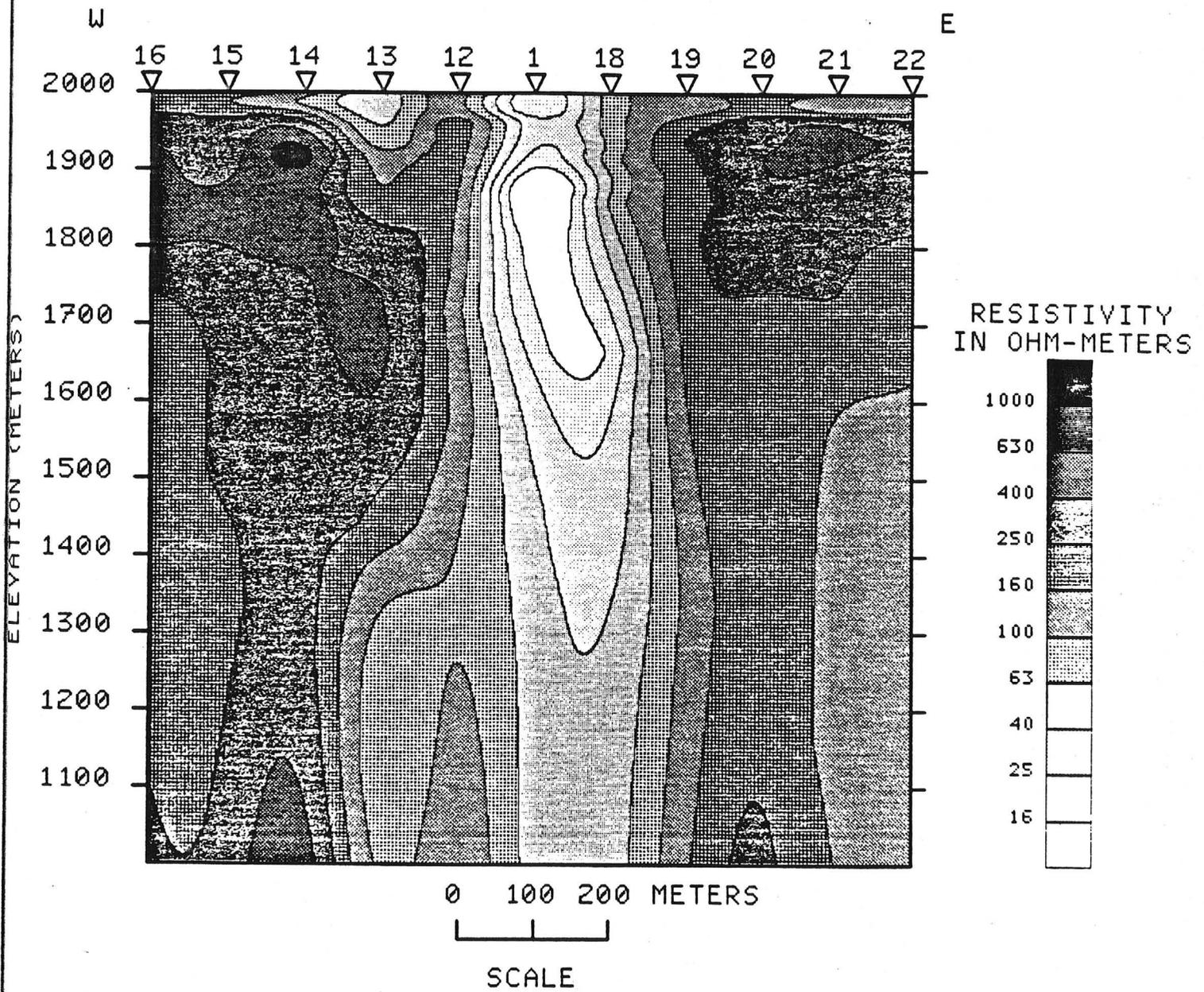


Figure 4 East-west cross section showing resistivity versus depth at site EZ-2.

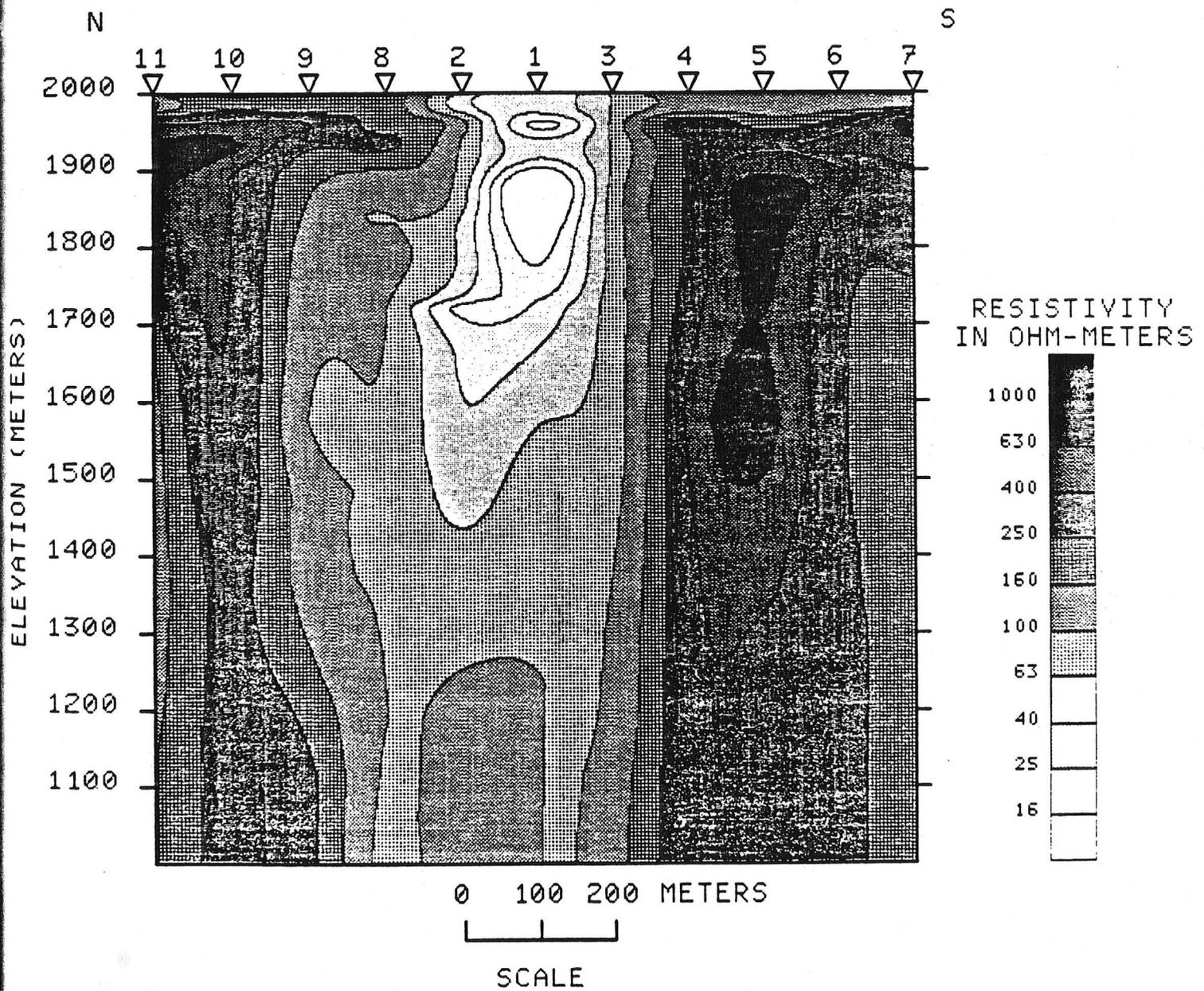


Figure 5 North-south cross section showing resistivity versus depth at site EZ-2.