



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX LABORATORY
1337 S. 46TH STREET BLDG 201
RICHMOND, CA 94804-4698

MEMORANDUM

SUBJECT: XRF Field Analytical Support at the Iron King/Humboldt Smelter Site,
Dewey-Humboldt, AZ

FROM: Greg Nagle, Environmental Scientist *GN*
EPA Region 9 Laboratory (MTS-2)

THROUGH: Brenda Bettencourt, Director *B. Bettencourt*
EPA Region 9 Laboratory (MTS-2)

TO: Monika O'Sullivan, RPM
Superfund Division (SFD-6-2)

Greg Nagle of the US Environmental Protection Agency (EPA), Region 9 Laboratory Field and Biology Team prepared this Field Report (attached) to document the analysis of soils in the field and at the Region 9 Laboratory using XRF technology, and the collection of concurrent GPS location data for all sample locations. The work was performed near the Iron King Mine/Humboldt Smelter located near the towns of Dewey and Humboldt, Arizona on April 16-19, 2012.

If there are further questions concerning this data collection effort, please contact me at (510) 412-2334.

ATTACHMENT: Field Report

Iron King Mine Humboldt Smelter Site, Dewey-Humboldt, Arizona

April 16-19, 2012 - Field Report

Introduction:

On April 16-19, 2012, Greg Nagle of the US Environmental Protection Agency (EPA) Region 9 Laboratory Field and Biology Team assisted Jeff Dhont of the EPA Region 9 Superfund Division with the collection and analysis of surface soils for metals using XRF near the Iron King Mine/Humboldt Smelter (IKHS) Superfund Site in Humboldt, Arizona. Samples of surface soils were collected in plastic bags and immediately analyzed by X-Ray Fluorescence (XRF). Documentation of the location includes global position system (GPS) readings, geologic formation, and photos.

Participants:

Greg Nagle performed XRF analyses and GPS data collection.

Jeff Dhont selected sample locations, identified geologic formations, collected photos, and maintained field notebooks of all activities.

Site Activities:

GPS Locations

GPS readings were collected at all 71 locations sampled using a Garmin e-Trex-30. At many locations a second sample was collected at a depth of 6-12 inches below ground surface (bgs). A separate GPS reading was not obtained for those samples collected at depth. GPS data is provided in Attachment A, and mapped below.

Figure 1 - IKHS XRF Sample Locations



Sample Collection/Preparation

At each location, samples were collected using a trowel placing approximately 2 ounces of the top ½ inch of soil in a plastic bag. At a number of locations, a shovel was used to remove the upper 6-12 inches of soil to collect a sample at depth. When a road cut face was available a second sample was collected from approximately 12 inches bgs on the face of the slope, by removing the surface soil and collecting approximately 2 ounces of the underlying soil. The samples were hand mixed in the plastic bags by manually breaking up large particles to create a sample of the finest, most uniform particles in the field.

Sample Analysis

The samples were analyzed within minutes of collection using a Niton® Model XL3t XRF analyzer. The sample run was performed using the Standard Range Filter with a 60-second analysis time. The elements detected include: arsenic, lead, selenium, copper, zinc, nickel, mercury, iron, manganese, uranium, molybdenum, zirconium, strontium, rubidium, thorium, tungsten and cobalt. The main elements of interest at the site were arsenic and lead. Instrument calibration was evaluated for those elements only. Each sample was analyzed in duplicate by turning the bag to expose a different surface and performing an identical XRF analysis.

Sample Precision

The average Relative Percent Difference (RPD) for all the replicate analyses performed in the field was 26 % for Arsenic and 30% for Lead. This includes all samples where the metal of interest was detected in both replicates. The XRF data collected in the field is provided as Attachment A and can be found in the file attached in the electronic transmittal IKHS_Field XRF Data_April2012.xls.

Sample Accuracy

Data quality of the XRF results also was assessed using standard reference materials. The XRF system was challenged with these reference materials, as well as a blank soil, before, during and after the analyses performed. All the recoveries for arsenic and lead fell within certified values. Arsenic and lead were not detected in the blank.

Precision and Accuracy Sample Results

SAMPLE	As Result (ppm)	As True Value (ppm)	As % Recovery	Pb Result (ppm)	Pb True Value (ppm)	Pb % Recovery
SiO2 Blank	< LOD	ND	NA	< LOD	ND	NA
SiO2 Blank	< LOD	ND	NA	< LOD	ND	NA
SRM 2709	16.76	17.7	95	18.17	18.9	96
SRM 2710	677.56	626	108	5449.41	5532	99
SRM 2711	100.88	105	96	1142.66	1162	98
DC 73308	22.38	25	90	26.15	27	97
DC 73308	19.29	25	77	24.31	27	90
SRM 7411	158.08	205	77	2781.56	2700	103
SRM180438	26.65	25	107	24.82	25	99

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Attachment A
Iron King Mine - Humboldt Smelter April 2011
GPS Coordinates WGS 84

name	lat	Lon	name	lat	Lon	name	Lat	lon
201	34.501151	112.261243	249	34.498908	112.219296	297	34.513937	-112.235352
203	34.499383	112.262637	251	34.499946	112.220532	299	34.519360	-112.236894
205	34.497529	112.263705	253	34.500338	112.224926	301	34.529944	-112.239580
207	34.497875	112.266368	255	34.499133	112.227204	303	34.535612	-112.236866
209	34.498825	112.266604	257	34.497451	112.224713	305	34.541011	-112.223919
211	34.492800	112.265354	259	34.497337	112.224708	307	34.515404	-112.242243
213	34.491096	112.245474	261	34.495520	112.224156	309	34.514416	-112.252450
215	34.491074	112.243782	263	34.497892	112.234020	311	34.513235	-112.250662
217	34.490910	112.243779	265	34.497960	112.233188	313	34.511643	-112.248682
219	34.491338	112.241989	267	34.497724	112.232716	315	34.515667	-112.255282
221	34.491598	112.238740	269	34.497948	112.231732	317	34.516628	-112.257641
223	34.491567	112.236613	271	34.498005	112.231997	319	34.517632	-112.267027
225	34.491653	112.234722	273	34.496531	112.230976	321	34.517084	-112.271216
227	34.490985	112.233197	275	34.496219	112.231437	323	34.514204	-112.270101
229	34.490616	112.230972	277	34.495286	112.231397	325	34.512336	-112.268778
231	34.490065	112.231415	279	34.494704	112.232560	327	34.509727	-112.263548
233	34.489908	112.239548	281	34.494666	112.233265	329	34.509637	-112.263610
235	34.486553	112.239337	283	34.495354	112.233749	331	34.509881	-112.263673
237	34.491513	112.240286	285	34.496131	112.233932	333	34.509668	-112.263722
239	34.501919	112.215960	287	34.496861	112.234943	335	34.509628	-112.263238
241	34.499909	112.215937	289	34.497041	112.235365	337	34.520897	-112.272576
243	34.494882	112.212796	291	34.496759	112.235964	339	34.512941	-112.275545
245	34.493614	112.216448	293	34.496487	112.236168	341	34.512856	-112.275720
247	34.489392	112.219011	295	34.509592	112.232164			

**Attachment B
Iron King Mine - Humboldt Smelter
XRF Results for Arsenic and Lead - April 2012**

SAMPLE	As (mg/kg)	Pb (mg/kg)	As - Average (a+b/2) (mg/kg)	Pb - Average (a+b/2) (mg/kg)	As RPD (%)	Lead RPD (%)
201a	31.86	28.13	32.1	23.6	1.4	38.5
201b	32.32	19.04				
202a	26.77	16.73	27.8	16.7	7.1	60.1
202b	28.73	< 9				
203a	35.78	17.72	48.9	30.5	53.6	83.7
203b	61.99	43.22				
204a	24.56	< 9	23.5	11.8	9.0	26.7
204b	22.44	11.77				
205a	73.64	33.67	62.6	37.3	35.3	19.6
205b	51.55	40.99				
206a	26.66	19.3	31.9	15.0	32.8	56.9
206b	37.12	10.75				
207a	15.43	9.64	18.9	9.6	37.0	18.6
207b	22.43	< 8				
208a	19.84	< 8	20.9	8.0	10.2	0.0
208b	21.98	< 8				
209a	16.37	17.18	15.6	17.1	10.4	1.1
209b	14.75	16.99				
210a	12.33	13.17	12.9	13.2	8.6	48.8
210b	13.44	< 8				
211a	86.77	20.93	87.0	21.4	0.5	4.4
211b	87.17	21.87				
212a	75.01	13.81	73.2	11.7	5.0	37.0
212b	71.34	9.5				
213a	21.86	33	23.4	29.4	12.8	24.6
213b	24.84	25.78				
214a	< 8	21.39	15.5	20.5	63.8	8.9
214b	15.5	19.57				
215a	< 11	37.86	12.1	34.3	9.5	20.6
215b	12.1	30.8				
216a	10.27	15.38	10.3	22.4	13.2	62.5
216b	< 9	29.35				
217a	10.7	26.32	10.5	24.2	3.2	18.0
217b	10.36	21.98				
219a	20.47	36.58	21.3	34.3	8.0	13.1
219b	22.18	32.07				
220a	11.42	23.44	11.4	22.2	35.2	11.3
220b	< 8	20.94				
221a	< 10	40.64	10.8	37.7	7.4	15.5
221b	10.77	34.79				
222a	14.57	22.08	14.6	22.9	58.2	7.4
222b	< 8	23.77				
223a	50.81	106.6	58.1	116.1	25.0	16.4
223b	65.34	125.62				

Attachment B
Iron King Mine - Humboldt Smelter
XRF Results for Arsenic and Lead - April 2012

SAMPLE	As (mg/kg)	Pb (mg/kg)	As - Average (a+b/2) (mg/kg)	Pb - Average (a+b/2) (mg/kg)	As RPD (%)	Lead RPD (%)
224a	33.19	51.75	34.0	44.7	4.9	31.8
224b	34.84	37.55				
225a	99.96	157.62	105.3	168.2	10.1	12.6
225b	110.6	178.86				
226a	< 8	18.59	8.0	8.0	0.0	37.7
226b	< 8	12.69				
227a	72.06	180.02	69.9	179.7	6.3	0.3
227b	67.66	179.42				
228a	100.15	9.57	103.4	12.9	6.3	51.4
228b	106.69	16.19				
229a	88.11	210.51	92.7	195.4	9.9	15.4
229b	97.31	180.33				
230a	187.13	361.13	198.5	350.9	11.4	5.8
230b	209.77	340.68				
231a	29.87	20.47	38.3	20.8	43.9	2.7
231b	46.65	21.04				
232a	16.02	18.51	18.2	17.9	24.0	7.3
232b	20.39	17.21				
233a	34.79	63.72	39.9	61.8	25.4	6.3
233b	44.92	59.82				
234a	< 8	21.17	8.5	8.5	11.8	2.1
234b	< 9	20.73				
235a	119.33	76.77	115.4	80.1	6.7	8.2
235b	111.56	83.35				
237a	19.12	28.06	17.8	31.4	14.8	21.2
237b	16.49	34.7				
238a	8.97	18.59	9.0	19.3	24.7	7.8
238b	< 7	20.1				
239a	44.42	19.13	45.0	15.3	2.4	50.5
239b	45.52	11.42				
240a	41.99	13.54	44.1	11.8	9.8	29.0
240b	46.3	10.11				
241a	52.94	20.17	50.6	27.3	9.4	52.0
241b	48.17	34.34				
242a	52.36	13.07	53.0	15.6	2.3	32.8
242b	53.57	18.2				
243a	73.18	9.2	62.0	10.9	36.1	31.1
243b	50.81	12.59				
244a	43.86	16.18	51.2	14.0	28.5	32.0
244b	58.46	11.72				
245a	25.41	15.3	23.4	15.3	16.9	62.7
245b	21.45	< 8				
246a	18.38	8.86	22.5	8.9	36.6	23.5
246b	26.61	< 7				

Attachment B
Iron King Mine - Humboldt Smelter
XRF Results for Arsenic and Lead - April 2012

SAMPLE	As (mg/kg)	Pb (mg/kg)	As - Average (a+b/2) (mg/kg)	Pb - Average (a+b/2) (mg/kg)	As RPD (%)	Lead RPD (%)
247a	54.24	< 8	51.6	11.9	10.1	38.9
247b	49.03	11.86				
248a	44.15	< 8	40.7	10.5	16.8	26.6
248b	37.3	10.45				
249a	28.72	14.41	34.1	14.4	31.8	57.2
249b	39.56	< 8				
250a	37.92	14.55	37.8	14.3	0.6	3.1
250b	37.71	14.11				
251a	54.66	18.12	49.9	16.0	19.2	26.7
251b	45.08	13.85				
252a	74.19	10.69	79.5	12.5	13.5	29.0
252b	84.9	14.31				
253a	72.74	30.39	63.1	29.9	30.7	3.3
253b	53.37	29.39				
254a	44.04	9.82	51.4	9.8	28.7	33.5
254b	58.81	< 7				
255a	45.89	68.39	41.4	62.3	21.8	19.5
255b	36.86	56.23				
256a	31.73	30.69	28.2	24.2	25.2	53.3
256b	24.64	17.77				
257a	83.4	36.16	74.4	36.0	24.1	0.9
257b	65.48	35.85				
258a	62.57	25.81	61.4	24.9	3.7	7.0
258b	60.28	24.06				
259a	44.46	52.36	59.7	43.8	51.0	38.9
259b	74.92	35.3				
261a	85.34	63.88	76.3	55.1	23.8	31.8
261b	67.21	46.36				
262a	58.36	18.43	62.3	16.5	12.7	23.3
262b	66.27	14.59				
263a	53.5	187.02	75.7	223.4	58.7	32.5
263b	97.98	259.69				
264a	72.39	293.66	65.8	251.8	20.0	33.3
264b	59.23	209.84				
265a	25.31	280.08	29.4	312.0	27.8	20.4
265b	33.48	343.87				
267a	69.44	425.07	88.4	456.0	42.9	13.6
267b	107.41	487				
269a	54.41	479.94	45.3	428.6	40.2	23.9
269b	36.19	377.34				
270a	17.88	20.01	13.3	21.5	69.3	13.6
270b	8.68	22.92				
271a	< 19	302.1	19.0	19.0	0.0	1.5
271b	< 19	306.62				

Attachment B
Iron King Mine - Humboldt Smelter
XRF Results for Arsenic and Lead - April 2012

SAMPLE	As (mg/kg)	Pb (mg/kg)	As - Average (a+b/2) (mg/kg)	Pb - Average (a+b/2) (mg/kg)	As RPD (%)	Lead RPD (%)
273a	139.31	109.2	147.5	123.9	11.1	23.8
273b	155.73	138.68				
274a	50.87	74.97	58.5	71.1	26.1	11.0
274b	66.12	67.15				
275a	126.64	56.19	127.1	61.2	0.7	16.3
275b	127.59	66.13				
276a	69.91	31.9	80.2	35.6	25.6	20.6
276b	90.42	39.23				
277a	108.65	211.58	116.0	201.8	12.7	9.7
277b	123.42	191.99				
278a	89.85	81.6	78.9	69.1	27.7	36.4
278b	68.02	56.5				
279a	214.84	1251.06	221.3	1184.4	5.8	11.3
279b	227.75	1117.69				
280a	34.89	65.22	32.4	67.8	15.1	7.6
280b	29.98	70.38				
281a	120.64	340.36	111.2	287.7	17.0	36.6
281b	101.76	234.96				
282a	122.88	369.92	126.8	337.5	6.1	19.2
282b	130.63	305.09				
283a	78.86	205.98	74.6	218.9	11.4	11.8
283b	70.32	231.73				
284a	57.32	145.51	55.0	174.9	8.4	33.6
284b	52.68	204.35				
285a	63.71	104.92	58.7	101.7	17.2	6.3
285b	53.62	98.56				
286a	47.06	101.68	46.1	87.8	4.0	31.6
286b	45.2	73.96				
287a	92.54	221.34	94.2	216.5	3.4	4.5
287b	95.78	211.67				
288a	23.7	39.91	22.8	38.1	8.2	9.4
288b	21.84	36.34				
289a	100.12	182.04	101.4	191.1	2.6	9.5
289b	102.77	200.19				
291a	152.58	216.06	163.0	215.7	12.7	0.3
291b	173.33	215.33				
293a	190.43	200.4	178.8	205.1	13.0	4.6
293b	167.16	209.76				
295a	23.81	38.32	22.2	40.8	15.0	12.2
295b	20.49	43.29				
296a	18.67	38.33	20.8	34.3	20.2	23.4
296b	22.87	30.31				
297a	28.7	45.58	24.2	41.7	36.7	18.5
297b	19.79	37.88				

Attachment B
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XRF Results for Arsenic and Lead - April 2012

SAMPLE	As (mg/kg)	Pb (mg/kg)	As - Average (a+b/2) (mg/kg)	Pb - Average (a+b/2) (mg/kg)	As RPD (%)	Lead RPD (%)
299a	11.28	12.04	12.9	12.5	24.4	6.7
299b	14.42	12.88				
300a	13.45	15.83	16.1	14.7	32.4	15.4
300b	18.65	13.56				
301a	14.79	29.93	15.7	28.1	11.7	12.7
301b	16.63	26.35				
302a	16.7	29.58	16.8	34.3	1.4	27.4
302b	16.93	38.97				
303a	20.16	46.35	23.0	42.3	24.4	18.9
303b	25.77	38.34				
304b	12.45	45.15	25.4	32.1	101.9	81.5
305a	38.3	19.01				
305b	38.56	22.87	36.5	19.9	11.4	30.2
306a	34.4	16.87				
306b	35.05	15.45	28.0	16.7	50.3	14.9
307a	20.97	17.93				
307b	19.26	19.65	14.9	13.9	58.3	82.9
308a	10.57	8.13				
308b	15.11	12.03	31.3	26.0	103.4	107.3
309a	47.47	39.9				
309b	46.02	40.33	35.5	28.0	59.5	87.8
310a	24.93	15.72				
310b	18.56	20.15	51.7	40.3	128.2	100.0
311a	84.9	60.42				
311b	96.13	68.78	58.9	41.4	126.2	132.4
312a	21.75	14				
312b	20.62	11.76	44.6	30.5	107.5	122.8
313a	68.51	49.21				
313b	66.51	74.35	41.9	44.0	117.8	137.8
314a	17.19	13.7				
314b	18.1	< 7	19.2	19.3	11.7	93.4
315a	20.35	19.27				
315b	29.32	29.09	21.7	21.6	70.2	69.9
316a	14.08	14.03				
316b	14.73	15.19	23.5	26.7	74.5	86.4
317a	32.21	38.29				
317b	46.79	34.5	35.4	25.3	64.6	72.4
318a	23.95	16.16				
318b	12.7	12.11	12.9	10.8	3.0	24.3
319a	13.09	9.49				
319b	17.46	12.89	16.5	24.7	11.1	95.6
3204a	15.63	36.51				
320a	17.28	13.92	15.5	14.5	23.0	7.4
320b	13.71	14.99				

Attachment B
Iron King Mine - Humboldt Smelter
XRF Results for Arsenic and Lead - April 2012

SAMPLE	As (mg/kg)	Pb (mg/kg)	As - Average (a+b/2) (mg/kg)	Pb - Average (a+b/2) (mg/kg)	As RPD (%)	Lead RPD (%)	
321a	7.28	< 7	17.7	9.0	117.7	24.6	
321b	28.11	8.96					
322a	8.95	14.42	10.6	13.7	31.1	10.2	
322b	12.25	13.02					
323a	51.27	10.35	61.2	11.4	32.5	18.8	
323b	71.17	12.5					
324a	106.66	< 7	113.8	7.5	12.5	13.3	
324b	120.84	< 8					
325a	24.67	14.88	27.3	20.8	19.3	56.8	
325b	29.94	26.67					
326a	22.16	9.67	22.0	11.2	1.7	27.3	
326b	21.78	12.73					
327a	73.06	13.55	77.8	17.3	12.2	43.2	
327b	82.52	21.02					
329a	70.4	19.98	90.0	22.1	43.6	19.2	
329b	109.62	24.23					
331a	52.35	31.81	58.5	32.8	21.1	6.2	
331b	64.72	33.84					
333a	195.84	12.02	180.5	11.3	17.0	12.8	
333b	165.1	10.57					
335a	63.35	22.2	63.1	26.5	0.8	32.3	
335b	62.83	30.76					
337a	16.24	12.1	14.9	13.3	18.2	18.7	
337b	13.53	14.59					
338a	11.91	< 7	10.3	7.0	31.4	0.0	
338b	8.68	< 7					
339a	8.87	9.27	9.7	11.6	16.3	40.4	
339b	10.44	13.96					
341a	19.05	65.45	19.2	57.4	1.8	27.9	
341b	19.4	49.43					
MAX	227.8	1251.1	221.3	1184.4	AVE	26.1	30.3