308 --- Q200312080006

Scientific Notebooks No. 080: Mineralogic, Chemical, and Isotopic Analyses for the Geochemical Natural Analog Project (06/01/1993 through 01/30/1996)

AN-3

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Analogs Book - # 3
An-3

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Geochemical Analog of Contaminant Transport in Unsaturated Rock Research Project

Initial Entries 6/1/93 by Bret Leslie BWL

This book is continuation of the contents of AN-1 Scientific Notebook # 024.
This book chronicles the laboratory investigation of the Analogs Research Project.

6/19/93
BWL

Whole Rock analyses Texas Tech

Major Element Analyses

Sampl #		SiO2	TiO2	Al2O3	Fe2O	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	TOTAL	Sr	Ba	Zr	Y
1401	5339	73.11	0.19	9.19	10.52	0.01	0.01	0.14	0.18	2.83	0.01	3.42	99.60	48	473	255#	32.0
1402	5345	76.42	0.25	12.87	0.59	0.00	0.03	0.10	0.54	6.06#	0.01	2.41	99.28	39	67	250#	34.3
1403	5349	75.29	0.21	9.27	4.42	0.01	0.01	0.44	0.09	1.98	0.03	4.29	96.02	97	382	291#	73.8
1404	5352	73.39	0.26	13.62	1.87	0.04	0.28	1.20	4.04	4.10	0.04	1.07	99.90	104	818	217	25.7
1405	5351	77.48	0.24	13.03	0.61	0.01	0.03	0.09	0.30	4.80#	0.02	2.92	99.53	45	118	247#	40.7
1406	5344	73.00	0.23	15.37	3.33	0.00	0.01	0.09	0.11	1.67	0.02	6.56	100.38	119	147	208	10.6
1407	5335	62.63	0.80	15.95	5.94	0.16	1.68	5.05	5.14#	1.82	0.72#	1.30	101.19	184	380	224	55.1
1408	5340	63.21	0.77	15.68	5.61	0.16	1.52	4.14	5.19#	2.09	0.24	0.52	99.12	167	384	225	54.3
1409	5343	59.18#	0.69	14.84	5.38	0.13	2.52	5.25	2.77	1.73	0.89#	6.87	100.25	267	470	160	30.8
1410	5338	48.90	2.97#	13.63	12.44	0.18	7.27	11.51#	2.41	0.56	0.31	0.33	100.51	392	131	167	28.1
1411	5347	77.46	0.22	12.37	0.71	0.00	0.02	0.13	0.31	4.25	0.01	3.22	98.72	56	82	206	23.5
1413	5353	76.38	0.24	12.79	0.72	0.01	0.12	0.13	0.53	6.36#	0.02	2.49	99.78	31	68	235#	38.4
1414	5356	56.31	0.84	16.59	7.68	0.16	3.15	7.24	3.48	1.52	0.12	1.94	99.03	235	356	135	31.3
1415	5330	59.59	0.72	14.25	5.75	0.14	2.59	5.15	2.94	1.74	0.64#	6.12	99.63	220	413	161	33.3
1416	5329	59.95	0.15	8.56	26.01#	0.01	0.01	0.14	0.06	0.97	0.01	4.72	100.60	57	243	527#	52.5
1418	5360	77.01	0.25	13.28	0.57	0.00	0.01	0.11	0.43	5.77#	0.02	2.83	100.28	35	85	307#	76.1
1419	5336	76.57	0.22	10.97	4.09	0.01	0.02	0.10	0.23	3.61	0.00	3.42	99.25	63	127	226	16.5
1420	5359	77.02	0.26	13.73	0.44	0.00	0.03	0.10	0.31	4.63	0.01	3.26	99.80	53	79	266#	37.4
1421	5357	78.25	0.23	12.65	0.57	0.00	0.02	0.07	0.31	4.77	0.02	3.12	100.02	52	120	246#	33.4
1906	5348	76.92	0.22	11.72	1.63	0.01	0.02	0.09	0.30	4.59	0.01	3.27	98.78	52	567	214	18.5

out of range of standard calibration

sample	element	comment
1410	Ti	should be good ± 2%
1416	Fe	may be off by as much as 10%; probably high -
1410	Ca	should be OK ± 4%
OK 1407	Na	should be good ± 3%
OR 1408	Na	"
1402	K	should be OK ± 4%
1405	K	"
1413	K	"
1418	K	"
OK 1407	P	should be good ± 2%
1409	P	"
OR 1415	P	"
(.....)	Zr	samples under 300 should be fine
1416	Zr	needs to be checked for sure; probably high
(....)	Y	samples under 40 should be fine; others probably high

The results presented on pages 2-6 are reflective of the analyses purchased on PO's 68009 (Req No 869605) and PO 49146 (Req No 850679). These represent the completed analyses and completed PO for PO 49146. Results for item A on 68009(PO) have not yet been received nor ~~Zn, Cr,~~ BWL 6/19/93 Cr, Ni, Zr results in line B of PO 68009.

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Minor Elements and FeO
Reanalysis of Zn & Y (pg 4)
Corrected Zn, Y values!

Sample	#	Zn ppm	Y ppm	Rb ppm	FeO wt%
1401	5944	356	30.5	137	0.06
1402	5912	88	38.8	338	0.1
1403	5948	1325	67.1	81	0.51
1404				150	1.28
1405	5916	313	38.9	245	0.09
1406				59	0.12
1407	5943	84	49.0	58	1.65
1408	5945	79	50.6	63	1.74
1409				61	1.87
1410				11	8.02
1411	5913	185	23.6	228	0.01
1412	5931	28	31.2	294	0.15
1413	5917	117	35.8	341	0.16
1414				48	3.17
1415	5937	81	31.7	62	1.99
1416	5933	1297	49.2	41	0.31
1417	5927	91	10.5	168	1.61
1418	5921	99	65.0	300	0.18
1419	5934	330	16.8	170	0.09
1420	5920	145	33.9	245	0.1
1421	5918	146	30.6	245	0.08
1422	5925	321	38.3	242	0.08
1423	5932	316	15.8	168	0.12
1424	5928	247	50.6	120	2.17
1425	5995	1423	51.1	42	0.23
1901	6004	355	33.5	217	0.16
1902	5970	196	21.2	243	0.08
1903	5998	1351	118.5	133	0.29
1904				169	1.32
1905	6002	435	45.4	137	0.15
1906	5914	162	18.9	247	0.12
1907	5962	239	37.4	253	0.11
1908	5963	364	15.8	185	0.12
1909	5977	1900	275.1	96	0.15
1910	5973	645	22.0	161	0.15
1911	5952	1155	119.8	132	0.23
1912	5987	247	51.1	119	2.21
1913	5980	2335	100.6	87	0.21
1914	5992	807	81.4	123	0.3
1915	5990	375	15.7	184	0.11

Sample #	SiO2	TiO2	Al2O3	Fe2O	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	TOTAL	Sr	Ba	Zr	Y
1412	5278	74.89	0.24	12.80	1.54	0.04	0.13	0.54	1.09	6.67#	0.09	2.81	100.84	70	159	227	34.1
1417	5279	68.88	0.47	15.49	2.70	0.04	0.72	1.94	4.08	4.56*	0.14	0.61	99.63	489	1855#	319	10.7
1422	5281	77.18	0.24	12.71	0.60	0.01	0.03	0.10	0.32	5.04*	0.04	2.95	99.19	44	118	226	39.2
1423	5275	76.52	0.22	11.20	4.13	0.01	0.03	0.11	0.24*	3.69	0.02	3.41	99.56	63	125	212	16.4
1424	5284	60.65	0.12	17.59	5.07	0.24	0.09	1.14	8.53*	4.30	0.17	1.57	99.46	700	580	1023#	54.8
1425	5274	60.22	0.15	8.47	24.72*	0.01	0.02	0.15	0.07	0.99	0.02	4.72	99.54	55	248	474#	54.4
1901	5268	76.59	0.24	12.02	1.34	0.01	0.04	0.09	0.28	4.50	0.06	3.50	98.66	67	174	241	33.7
1902	5250	74.93	0.22	11.45	3.91	0.01	0.02	0.10	0.32	4.84	0.04	3.29	99.12	43	633	221	21.5
1903	5273	76.86	0.21	10.22	4.69	0.01	0.02	0.11	0.15	2.99	0.06	3.82	99.14	89	301	434	155.3
1904	5266	69.40	0.48	15.09	2.60	0.04	0.76	1.93	4.07	4.48	0.13	0.59	99.56	475	1838#	319*	10.1
1905	5269	76.31	0.27	13.04	2.45	0.01	0.06	0.09	0.16	3.19	0.04	4.53	100.14	87	190	274*	49.0
1907	5254	73.99	0.26	14.10	1.14	0.01	0.04	0.08	0.30	5.18*	0.05	4.03	99.17	66	75	252*	39.2
1908	5252	79.08	0.24	10.88	1.62	0.01	0.03	0.13	0.23	4.02	0.05	3.49	99.77	61	138	246*	16.0
1909	5265	77.97	0.20	8.97	5.66	0.01	0.01	0.11	0.13	2.27	0.06	4.00	99.38	81	308	529*	441.9
1910	5251	77.46	0.24	11.17	2.53	0.01	0.02	0.12	0.21	3.47	0.03	4.02	99.27	64	143	267	21.7
1911	5256	77.47	0.21	9.92	4.61	0.01	0.02	0.10	0.15	2.89	0.06	3.79	99.24	86	306	445*	157.0
1912	5262	59.90	0.13	17.97	5.40	0.24	0.09	1.16	8.45*	4.21	0.16	1.57	99.30	713	583	1023*	54.5
1913	5264	71.94	0.18	12.78	6.19	0.01	0.05	0.17	0.11	1.98	0.04	5.84	99.29	72	269	508*	114.4
1914	5258	77.27	0.22	10.07	3.95	0.01	0.02	0.12	0.15	2.83	0.11	4.64	99.39	221	409	500*	95.2
1915	5261	78.57	0.24	11.23	1.71	0.01	0.03	0.14	0.24	4.16	0.02	3.49	99.82	65	141	233	15.6

1912 } = STM
1424 }

out of range of standard calibration

sample	element	comment
1425	Fe	maybe 5-10% high
1912	Na	should be OK
1424	"	"
1412	K	should be good
1422	"	"
1907	"	"
1417	Ba	needs to be reanalyzed — these look to be standards
1904	"	"
(...)	Zr	samples under 300 should be fine, but these need to be checked
(....)	Y	samples under 40 should be fine

note: Zr usually more accurate on majors rather than trace run b/c of complexing problem with Si in concentrated solutions; although high Zr should be accurate; still I" check it

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Minor (Trace) Element Analyses

Sampl #		Sc	V	Cr	Ni	Cu	Zn	Nb	Y	Zr	Ba	Sr	
1401	5425	2.5	87	10	3	12	206 ±	19	31.4	257	492	49	✓
1402	5431	3.1	19	4	7	4	87	30	36.9 ±	256	69	38	✓
1403	5428	4.4	184	40	13	45	-870 ±	-26 ±	77.4 ±	291	397	100	✓
1404	5436	4.3	12	9	7	14	33	10	26.5	225	810	106	✓
1405	5435	1.6	169	7	8	18	312 ±	33	41.7 ±	249	119	43	✓
1406	5430	9.4	60	36	69	9	30	32	11.9	213	144	118	✓
1407	5421	17.3	58	9	6	20	79	12	51.9 ±	91	362	183	✓
1408	5426	17.2	50	6	2	10	61	10	53.1 ±	220	377	171	✓
1409	5429	14.8	98	41	18	44	77	9	30.4	47	465	264	✓
1410	5420	32.3	294 ±	278	68	90 ±	92	18	28.3	158	125	390	✓
1411	5433	1.7	29	12	16	7	182 ±	27	25.4	215	85	57	✓
1412	5414	3.1	15	6	3	0	30	31	35.9 ±	239	163	65	✓
1413	5438	3.3	20	8	23	2	113	36	38.9 ±	241	72	31	✓
1414	5439	25.8	199	10	18	16	74	10	31.1	138	347	226	✓
1415	5418	16.4	96	45	16	41	80	9	35.0 ±	156	415	222	✓
1416	5417	7.7	317 ±	14	53	31	-1000 ±	24	56.5 ±	539	241	54	✓
1417	5413	3.2	32	12	10	11	85	15	105.2 ±	326	1773 ±	477	✓
1418	5443	4.4	56	5	9	5	88	36	77.4 ±	305	85	33	✓
1419	5423	2.4	92	2	0	10	212 ±	36	15.7	219	126	62	✓
1420	5442	3.5	44	8	14	4	132 ±	36	37.6 ±	258	82	51	✓
1421	5440	2.6	64	7	18	5	140 ±	35	33.3	243	128	52	✓
1422	5411	1.6	171	6	11	19	213 ±	35	41.3 ±	231	115	41	✓
1423	5416	2.4	93	4	5	11	232 ±	34	17.3	219	126	61	✓
1424	5410	0.3	1	9	11	6	172 ±	328 ±	53.8 ±	1206 ±	552	703	✓
1425	5400	7.8	332	6	3	28	-1000 ±	24	54.4 ±	508	251	55	
1901	5407	3.0	73	5	1	11	232 ±	35	37.7 ±	257	188	71	✓
1902	5386	1.4	36	8	1	0	159 ±	20	20.5	222	616	42	✓
1903	5402	9.6	175	5	2	40	-1000 ±	33	158.3 ±	491	331	93	✓
1904	5408	3.4	34	10	6	10	80	15	10.6	339	1787 ±	494	✓
1905	5405	3.4	114	12	24	19	234 ±	41	52.0 ±	293	208	94	✓
1906	5434	2.0	28	10	6	0	161 ±	24	19.1	213	586	52	✓
1907	5383	2.3	46	5	6	10	185 ±	39	38.8 ±	258	75	66	✓
1908	5385	2.4	52	16	26	4	226 ±	31	15.9	248	145	63	✓
1909	5390	12.3	171	4	4	43	-2804 ±	32	434.0 ±	554	310	82	✓
1910	5388	3.0	79	42	70	9	152 ±	30	21.0	275	137	62	✓
1911	5382	8.9	149	4	7	37	-822 ±	33	145.0 ±	458	300	84	✓
1912	5394	0.4	0	3	1	9	196 ±	338 ±	54.5 ±	1201 ±	569	707	✓
1913	5392	12.9	173	4	3	38	-6000 ±	30	114.0 ±	515	265	69	✓
1914	5398	10.0	128	7	5	16	-30 ±	35	94.9 ±	511	410	219	✓
1915	5396	2.6	51	6	3	3	236 ±	31	15.9	248	153	68	✓

± out of range of standards

Zn calibration was way off causing a concave ⌒ curve thus the negative #
Y " " " "

Note the corrected Zn, Y and Rb & FeO analyses for these samples are located on page 3.

Also note that the analyst can pick out the "unknown standards" submitted for analysis. See analyst note on page 3 that 1912 & 1424 = STM. This is accurate!

6/19/93
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Major Element Analyses and FeO

Sample #	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	TOTAL	FeO	Sr	Ba	Zr	Y
41001 6915	76.57	0.23	12.32	0.93	0.01	0.07	0.19	0.59	4.38	0.15	0.57	99.65	1.56	463	1779	348	10.6
41003 6927	77.98	0.25	11.93	0.60	0.01	0.06	0.17	0.57	5.67	0.01	2.38	99.75	1.19	33	62	268	32.9
41004 6918	77.28	0.24	12.37	0.48	0.01	0.06	0.16	0.53	0.57	0.11	0.23	99.23	8.61	179	159	82	23.7
41005 6916	76.33	0.25	13.03	0.54	0.00	0.06	0.17	0.54	3.14	0.05	3.43	99.16	0.16	64	123	245	17.3
41006 6921	76.00	0.24	13.08	0.57	0.01	0.06	0.17	0.62	3.40	0.03	3.71	100.38	0.09	59	102	245	16.7
41008 6924	79.43	0.25	10.81	2.39	0.01	0.05	0.15	0.25	2.13	0.02	4.22	99.93	0.13	61	122	213	12.4
41009 6923	74.66	0.22	10.97	6.56	0.01	0.05	0.19	0.26	2.82	0.50	1.63	99.14	2.15	641	1124	221	20.0
41010 6919	66.17	0.29	16.09	8.25	0.01	0.05	0.19	0.14	1.55	0.07	7.08	99.88	0.16	232	297	561	41.1
41023 6926	79.49	0.24	10.57	2.38	0.01	0.05	0.15	0.25	3.14	0.02	3.53	99.81	0.16	63	123	244	17.0
41002 6893	69.48	0.48	15.19	2.68	0.04	0.75	1.90	4.03	4.38	0.15	0.57	99.65	1.56	463	1779	348	10.6
41003 6889	77.68	0.25	12.39	0.68	0.01	0.05	0.11	0.53	5.67	0.01	2.38	99.75	1.19	33	62	268	32.9
41007 6886	51.96	1.05	15.03	10.76	0.16	6.24	10.96	2.16	0.57	0.11	0.23	99.23	8.61	179	159	82	23.7
41008 6896	78.78	0.24	10.85	2.30	0.01	0.04	0.09	0.24	3.14	0.05	3.43	99.16	0.16	64	123	245	17.3
41009 6897	74.95	0.22	11.10	6.55	0.01	0.04	0.12	0.25	3.40	0.03	3.71	100.38	0.09	59	102	245	16.7
41011 6888	74.95	0.21	11.24	6.90	0.00	0.03	0.10	0.14	2.13	0.02	4.22	99.93	0.13	61	122	213	12.4
41012 6894	53.85	1.03	17.09	6.73	0.10	1.47	4.77	4.15	2.82	0.50	1.63	99.14	2.15	641	1124	221	20.0
41013 6885	71.77	0.20	15.45	3.25	0.00	0.04	0.06	0.06	0.55	0.01	8.21	99.60	0.13	146	225	234	11.3
41014 6880	71.68	0.19	12.94	6.16	0.00	0.01	0.04	0.04	0.64	0.01	7.42	99.13	0.18	282	508	297	10.9
41015 6882	72.72	0.21	14.11	0.77	0.00	0.02	0.05	0.06	1.58	0.01	10.74	100.28	0.17	349	448	266	11.5
41016 6883	74.47	0.22	14.61	0.64	0.00	0.02	0.07	0.07	0.89	0.02	8.33	99.33	0.15	189	237	227	11.2
41017 6879	74.54	0.24	12.23	1.40	0.07	0.12	0.38	1.06	6.36	0.07	2.50	99.00	0.19	63	159	228	33.0
41018 6857	78.20	0.22	10.83	0.94	0.01	0.07	0.06	0.11	1.07	0.02	8.16	99.67	0.23	186	428	398	12.4
41019 6877	74.18	0.21	12.45	1.37	0.00	0.08	0.07	0.06	1.32	0.01	9.31	99.08	0.23	291	349	283	12.2
41020 6874	74.32	0.23	14.13	1.54	0.00	0.04	0.06	0.08	1.48	0.03	8.22	100.13	0.16	196	303	224	10.6
41021 6848	77.55	0.24	12.29	0.56	0.00	0.04	0.06	0.20	2.82	0.04	6.08	99.90	0.14	143	168	237	13.9
41022 6876	76.54	0.25	13.33	0.65	0.01	0.05	0.13	0.58	6.58	0.02	2.41	100.56	0.05	65	64	256	34.4
41023 6850	78.91	0.24	10.60	2.38	0.01	0.04	0.07	0.23	3.17	0.04	3.53	99.21	0.16	63	124	240	17.6
41024 6871	72.02	0.20	13.19	6.52	0.00	0.03	0.06	0.06	0.65	0.01	7.49	100.21	0.2	289	536	323	11.1
41025 6852	77.20	0.25	12.25	0.56	0.00	0.04	0.06	0.19	2.72	0.03	6.12	99.42	0.13	141	163	230	13.7

6/19/93
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Minor (Trace) Element Analyses

Sample #		Sc	V	Cu	Zn	Nb	Y	Ba	Sr	Rb
41001	6983	3.8	24	3	130	35	35.3	74	22	360
41002	6985	4.0	34	15	102	13	11.3	1859	478	168
41003	6987	3.6	18	2	117	32	33.9	68	33	324
41004	6988	4.0	25	2	101	35	34.3	70	41	318
41005	6989	4.8	31	1	105	35	40.4	75	32	357
41006	6975	3.0	27	1	125	41	35.5	66	64	368
41007	6976	35.3	228	91	86	8	23.7	164	188	19
41008	6979	3.0	74	6	190	52	16.9	125	62	144
41009	6980	2.6	127	9	285	41	16.3	105	57	156
41010	6982	13.2	332	22	374	37	43.0	294	231	67
41011	6968	3.6	75	6	64	30	12.4	130	62	96
41012	6970	11.7	118	55	94	11	21.0	1168	670	67
41013	6971	12.2	138	8	98	31	11.9	227	158	10
41014	6972	15.8	116	6	37	30	11.1	519	292	10
41015	6974	36.8	124	4	37	38	12.1	451	362	12
41016	6958	28.7	133	4	36	35	10.9	233	190	12
41017	6959	3.2	14	2	33	34	32.1	168	62	304
41018	6961	26.7	112	6	42	36	11.9	409	177	14
41019	6962	24.9	142	11	57	34	12.4	345	287	16
41020	6984	18.6	191	8	56	35	11.0	292	194	39
41021	6951	15.3	104	5	29	40	13.8	170	146	103
41022	6952	3.1	26	4	112	41	34.7	68	64	347
41023	6954	2.4	77	6	189	42	17.4	129	66	136
41024	6955	15.6	114	6	26	31	10.8	530	297	9
41025	6957	15.7	105	5	22	38	13.7	159	148	105

Note for samples 41001 → 41025 analyses of Zr, Cr, Ni are not yet complete.

The identification of these samples have been previously described in AN-1 (024; pages 225, 227 and 275).

Note the analysts notes on problem elemental analyses and her estimated accuracy on problem samples. This is shown on pages 2-4. For samples numbered 411 XXX the analyst reported no problems other than the incomplete analyses for Ni, Cr and Zr during her three element run.

An attempt to summarize the results and analyze the quality of the reported values is conducted on the following pages.

It is unclear whether results quoted for 41 XXX series analyses Fe_2O_3 is TFe_2O_3 or the calculated from FeO analyses

6/20/93
BWL

Presentation of Major Element Analyses of Standards

qa major standards

T T ID	ID	SiO2	TiO2	Al2O3	TFe2O3	Fe2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5
G-2 Standard		**69.11**	**0.50**	**15.40**	**2.65**	**1.08**	**1.45**	**0.03**	**0.76**	**1.94**	**4.07**	**4.51**	**0.14**
1904	G2	69.40	0.48	15.09	2.60	1.13	1.32	0.04	0.76	1.93	4.07	4.48	0.13
1417	G2	68.88	0.47	15.49	2.70	0.92	1.61	0.04	0.72	1.94	4.08	4.56	0.14
41002	G2	69.48	0.48	15.19	2.68	0.95	1.56	0.04	0.75	1.90	4.03	4.38	0.15
% difference 1904		0.42	-4.00	-2.01	-1.89	4.39	-8.97	33.33	0.00	-0.52	0.00	-0.67	-7.14
% difference 1417		-0.33	-6.00	0.58	1.89	-15.04	11.03	33.33	-5.26	0.00	0.25	1.11	0.00
% difference 41002		0.54	-4.00	-1.36	1.13	-11.94	7.59	33.33	-1.32	-2.06	-0.98	-2.88	7.14
Average % difference		0.21	-4.67	-0.93	0.38	-7.53	3.22	33.33	-2.19	-0.86	-0.25	-0.81	0.00
STM-1 Stand.		**59.60**	**0.15**	**18.50**	**5.21**	**2.85**	**2.08**	**0.23**	**0.09**	**1.10**	**8.91**	**4.30**	**0.16**
1912	STM-1	59.90	0.13	17.97	5.40	2.90	2.21	0.24	0.09	1.16	8.45	4.21	0.16
1424	STM-1	60.65	0.12	17.59	5.07	2.63	2.17	0.24	0.09	1.14	8.53	4.30	0.17
% difference 1912		0.50	-13.33	-2.86	3.65	1.89	6.25	4.35	0.00	5.45	-5.16	-2.09	0.00
% difference 1424		1.76	-20.00	-4.92	-2.69	-7.86	4.33	4.35	0.00	3.64	-4.26	0.00	6.25
Average % difference		1.13	-16.67	-3.89	0.48	-2.98	5.29	4.35	0.00	4.55	-4.71	-1.05	3.13
RGM-1 Stand.		**72.70**	**0.27**	**13.80**	**1.87**	**0.49**	**1.23**	**0.04**	**0.28**	**1.13**	**4.03**	**4.33**	**0.05**
1404	RGM-1	73.39	0.26	13.62	1.87	0.46	1.28	0.04	0.28	1.20	4.04	4.10	0.04
% difference 1404		0.95	-3.70	-1.30	0.00	-5.92	4.07	0.00	0.00	6.19	0.25	-5.31	-20.00
BHVO-1 Stand.		**49.90**	**2.65**	**13.80**	**12.20**	**2.65**	**8.59**	**0.17**	**7.14**	**11.40**	**2.21**	**0.55**	**0.29**
1410	BHVO-1	48.90	2.97	13.63	12.44	3.59	8.02	0.18	7.27	11.51	2.41	0.56	0.31
% difference 1410		-2.00	12.08	-1.23	1.97	35.49	-6.64	5.88	1.82	0.96	9.05	1.82	6.90
W-2 Standard		**52.68**	**1.06**	**15.45**	**10.83**	**1.53**	**8.34**	**0.17**	**6.37**	**10.86**	**2.20**	**0.63**	**0.14**
41007	W-2	51.96	1.05	15.03	10.76	1.34	8.61	0.16	6.24	10.96	2.16	0.57	0.11
% difference 41007		-1.37	-0.94	-2.72	-0.65	-12.74	3.24	-5.88	-2.04	0.92	-1.82	-9.52	-21.43
AGV-1 Stand.		**59.00**	**1.04**	**17.25**	**6.76**	**4.51**	**2.05**	**0.10**	**1.53**	**4.90**	**4.26**	**2.89**	**0.49**
41012	AGV-1	58.85	1.03	17.09	6.73	4.26	2.15	0.10	1.47	4.77	4.15	2.82	0.50
% difference 41012		-0.25	-0.96	-0.93	-0.44	-5.57	4.88	0.00	-3.92	-2.65	-2.58	-2.42	2.04

6/20/93

Presentation of Major Element Analyses of Duplicate Samples

8
6/20/93
BWL

qa major duplicates

T T ID	ID	SiO2	TiO2	Al2O3	TFe2O3	FeO	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5
1903	11.78	76.86	0.21	10.22	4.69	0.29	4.25	0.01	0.02	0.11	0.15	2.99	0.06
1911	11.78	77.47	0.21	9.92	4.61	0.23	4.23	0.01	0.02	0.10	0.15	2.89	0.06
% difference		0.79	0.00	-2.94	-1.71	-20.69	-0.33	0.00	0.00	-9.09	0.00	-3.34	0.00
1908	12.65	79.08	0.24	10.88	1.62	0.12	1.45	0.01	0.03	0.13	0.23	4.02	0.05
1915	12.65	78.57	0.24	11.23	1.71	0.11	1.54	0.01	0.03	0.14	0.24	4.16	0.02
% difference		-0.64	0.00	3.22	5.56	-8.33	6.78	0.00	0.00	7.69	4.35	3.48	-60.00
1405	11.55	77.48	0.24	13.03	0.61	0.09	0.50	0.01	0.03	0.09	0.30	4.80	0.02
1422	11.55	77.18	0.24	12.71	0.60	0.08	0.50	0.01	0.03	0.10	0.32	5.04	0.04
% difference		-0.39	0.00	-2.46	-1.64	-11.11	0.18	0.00	0.00	11.11	6.67	5.00	100.00
1419	13.5	76.57	0.22	10.97	4.09	0.09	3.88	0.01	0.02	0.10	0.23	3.51	0.00
1423	13.5	76.52	0.22	11.20	4.13	0.12	3.88	0.01	0.03	0.11	0.24	3.69	0.02
% difference		-0.07	0.00	2.10	0.98	33.33	0.18	0.00	50.00	10.00	4.35	2.22	-100.00
1416	13.95	59.95	0.15	8.56	26.01	0.31	24.92	0.01	0.01	0.14	0.06	0.97	0.01
1425	13.95	60.22	0.15	8.47	24.72	0.23	23.76	0.01	0.02	0.15	0.07	0.99	0.02
% difference		0.45	0.00	-1.05	-4.96	-25.81	-4.69	0.00	100.00	7.14	16.67	2.06	100.00
41106	8.15	76.00	0.24	13.08	0.57	0.07	0.48	0.01	0.06	0.17	0.62	6.64	0.06
41022	8.15	76.54	0.25	13.33	0.65	0.05	0 58	0.01	0.05	0.13	0.58	6.58	0.02
% difference		0.71	4.17	1.91	14.04	-28.57	20.62	0.00	-16.67	-23.53	-6.45	-0.90	-66.67
41008	14.45	79.43	0.25	10.81	2.39	0.16	2.15	0.01	0.05	0.15	0.25	3.27	0.04
41023	14.45	78.91	0.24	10.60	2.38	0.16	2.14	0.01	0.04	0.07	0.23	3.17	0.04
% difference		-0.65	-4.00	-1.94	-0.42	0.00	-0.45	0.00	-20.00	-53.33	-8.00	-3.06	0.00
41014	18.05	71.68	0.19	12.94	6.16	0.18	5.79	0.00	0.01	0.04	0.04	0.64	0.01
41024	18.05	72.02	0.20	13.19	6.52	0.20	6.12	0.00	0.03	0.06	0.06	0.65	0.01
% difference		0.47	5.26	1.93	5.84	11.11	5.67	0.00	200.00	50.00	50.00	1.56	0.00
41021	20.65	77.55	0.24	12.29	0.56	0.14	0.40	0.00	0.04	0.06	0.20	2.82	0.04
41025	20.65	77.20	0.25	12.25	0.56	0.13	0.41	0.00	0.04	0.06	0.19	2.72	0.03
% difference		-0.45	4.17	-0.33	0.00	-7.14	2.68	0.00	0.00	0.00	-5.00	-3.55	-25.00

6/20/93
BWL

Presentation of Minor (Trace) Element Analysis of Standards

trace qa standards

T T ID	ID	Sr)m	Ba)m	Zr)m	Y)m	Sc	V	Cr	Ni	Cu	Zn	Nb	Y	Zr	Ba	Sr	Rb
G-2 Standard		**479**	**1870**	**300**	**12.0**	**3.7**	**35**	**7**	**5**	**12**	**85**	**14**	**12.0**	**300**	**1870**	**479**	**168**
1904	G2	475	1838	319	10.1	3.4	34	10	6	10	80	15	10.6	339	1787	494	169
1417	G2	489	1855	319	10.7	3.2	32	12	10	11	91	15	10.5	326	1773	477	168
41002	G2	463	1779	348	10.6	4.0	34			15	102	13	11.3		1859	478	168
% difference 1904		-0.84	-1.71	6.33	-15.83	-8.11	-2.86	42.86	20.00	-16.67	-5.88	7.14	-11.67	13.00	-4.44	3.13	0.60
% difference 1417		2.09	-0.80	6.33	-10.83	-13.51	-8.57	71.43	100.00	-8.33	7.06	7.14	-12.50	8.67	-5.19	-0.42	0.00
% difference 41002		-3.34	-4.87	16.00	-11.67	8.11	-2.86			25.00	20.00	-7.14	-5.83		-0.59	-0.21	0.00
Average % difference		-0.70	-2.46	9.56	-12.78	-4.50	-4.76	57.14	60.00	0.00	7.06	2.38	-10.00	10.83	-3.40	0.84	0.20
STM-1 Standard		**730**	**590**	**1260**	**53.0**	**0.7**	**2**	**3**	**2**	**4**	**230**	**270**	**53**	**1260**	**590**	**730**	**120**
1912	STM-1	713	583	1023	54.5	0.4	0	3	1	9	247	338	51.1	1201	569	707	119
1424	STM-1	700	580	1023	54.8	0.3	1	9	11	6	247	328	50.6	1206	552	703	120
% difference 1912		-2.33	-1.19	-18.81	2.83	-42.86	-100.00	0.00	-50.00	125.00	7.39	25.19	-3.58	-4.68	-3.56	-3.15	-0.83
% difference 1424		-4.11	-1.69	-18.81	3.40	-57.14	-50.00	200.00	450.00	50.00	7.39	21.48	-4.53	-4.29	-6.44	-3.70	0.00
Average % difference		-3.22	-1.44	-18.81	3.11	-50.00	-75.00	100.00	200.00	87.50	7.39	23.33	-4.06	-4.48	-5.00	-3.42	-0.42
RGM-1 Standard		**114**	**820**	**210**	**27.0**	**5.0**	**14**	**3**	**7**	**11**	**32**	**9**	**27.0**	**210**	**820**	**114**	**156**
1404	RGM-1	104	818	217	25.7	4.3	12	9	7	14	33	10	26.5	225	810	106	150
% difference 1404		-8.77	-0.24	3.33	-4.81	-14.00	-14.29	260.00	0.00	30.84	3.13	11.11	-1.85	7.14	-1.22	-7.02	-3.85
BHVO-1 Standard		**440**	**142**	**180**	**28.0**	**30.2**	**314**	**300**	**117**	**137**	**102**	**19**	**28.0**	**180**	**142**	**440**	**10**
1410	BHVO-1	392	131	167	28.1	32.3	294	278	68	90	92	18	28.3	158	125	390	11
% difference 1410		-10.91	-7.75	-7.22	0.36	6.95	-6.37	-7.33	-41.88	-34.31	-9.80	-5.26	1.07	-12.22	-11.97	-11.36	10.00
W-2 Standard		**192**	**174**	**100**	**23.0**	**35.7**	**259**	**92**	**70**	**106**	**80**	**7**	**23.0**	**100**	**174**	**192**	**21**
41007	W-2	179	159	82	23.7	35.3	228			91	86	8	23.7		164	188	19
% difference 41007		-6.77	-8.41	-18.00	3.04	-1.12	-11.97			-14.15	7.50	14.29	3.04		-5.53	-2.08	-9.09
AGV-1 Standard		**657**	**1208**	**225**	**21.3**	**13.4**	**125**	**12**	**19**	**60**	**84**	**15**	**21.3**	**225**	**1208**	**657**	**67**
41012	AGV-1	641	1124	221	20.0	11.7	118			55	94	11	21.0		1168	670	67
% difference 41012		-2.44	-6.95	-1.78	-6.10	-12.69	-5.60			-8.33	11.90	-26.67	-1.41		-3.31	1.98	0.00

10
6/20/93
BWR

Analysis of Duplicate Sample Analyses of Minor (Trace) Elements

trace qa duplicates

TT ID	ID	Sr)m	Ba)m	Zr)m	Y)m	Sc	V	Cr	Ni	Cu	Zn	Nb	Y	Zr	Ba	Sr	Rb
1903	11.78	89	301	434	155.0	9.6	175	5	2	40	1351	33	118.5	491	331	93	133
1911	11.78	86	306	445	157.0	8.9	149	4	7	37	1155	33	119.8	458	300	84	132
% difference		-3.37	1.66	2.53	1.29	-7.3	-15	-20	250	-8	-15	0	1.1	-7	-9	-10	-1
1908	12.65	61	138	246	16.0	2.4	52	16	26	4	364	31	15.8	248	145	63	185
1915	12.65	65	141	233	15.6	2.6	51	6	3	3	375	31	15.7	248	153	68	184
% difference		6.56	2.17	-5.28	-2.50	8.3	-2	-63	-88	-25	3	0	-0.6	0	6	8	-1
1405	11.55	45	118	247	40.7	1.6	169	7	8	18	313	33	38.9	249	119	43	245
1422	11.55	44	118	226	39.2	1.6	171	6	11	19	321	35	38.3	231	115	41	242
% difference		-2.22	0.00	-8.50	-3.69	0.0	1	-14	38	6	3	6	-1.5	-7	-3	-5	-1
1419	13.5	63	127	226	16.5	2.4	92	2	0	10	330	36	16.8	219	126	62	170
1423	13.5	63	125	212	16.4	2.4	93	4	5	11	316	34	15.8	219	126	61	168
% difference		0.00	-1.57	-6.19	-0.61	0.0	1	100	-100	10	-4	-6	-6.0	0	0	-2	-1
1416	13.95	57	243	527	52.5	7.7	317	14	53	31	1297	24	49.2	539	241	54	41
1425	13.95	55	248	474	54.4	7.8	332	6	3	28	1423	24	51.1	508	251	55	42
% difference		-3.51	2.06	-10.06	3.62	1.3	5	-57	-94	-10	10	0	3.9	-6	4	2	2
41006	8.15	64	63	244	33.9	3.0	27			1	125	41	35.5		66	64	368
41022	8.15	65	64	256	34.4	3.1	26			4	112	41	34.7		68	64	347
% difference		1.56	1.59	4.92	1.47	3.3	-4			300	-10	0	-2.3		3	0	-6
41008	14.45	64	124	256	17.5	3.0	74			6	190	52	16.9		125	62	144
41023	14.45	63	124	240	17.6	2.4	77			6	189	42	17.4		129	66	136
% difference		-1.56	0.00	-6.25	0.57	-20.0	4			0	-1	-19	3.0		3	6	-6
41014	18.05	282	508	297	10.9	15.8	116			6	37	30	11.1		519	292	10
41024	18.05	289	536	323	11.1	15.6	114			6	26	31	10.8		530	297	9
% difference		2.48	5.51	8.75	1.83	-1.3	-2			0	-30	3	-2.7		2	2	-10
41021	20.65	143	168	237	13.9	15.3	104			5	29	40	13.8		170	146	103
41025	20.65	141	163	230	13.7	15.7	105			5	22	38	13.7		159	148	105
% difference		-1.40	-2.98	-2.95	-1.44	2.6	1			0	-24	-5	-0.7		-6	1	2

Replicate Analyses of NOP-ECP-1 from 5/91 ⇒ 6/93
Long Term Reproducibility

6/20/93
BWL

T T ID	ID	Sr)m	Ba)m	Zr)m	Y)m	Sc	V	Cr	Ni	Cu	Zn	Nb	Y	Zr	Ba	Sr	Rb
5909	NOP-ECP					3.1	16	4	3	0	32	30	32	222	183	63	303
5912	-WR1/2					3.2	16	3	2	0	30	27	32.5	207	180	72	291
3105	5912					3.1	17	0	0	3	29	32	36.6	230	164	70	293
1412	5912	70	159	227	34.1	3.1	15	6	3	0	28	31	31.2	239	163	65	294
41017	5909	63	159	228	33	3.2	14			2	33	34	32.1		168	62	304
Average						3.1	15.6	3.3	2.0	1.0	30.4	30.8	32.9	224.5	171.6	66.4	297.0
STD						0.1	1.1	2.5	1.4	1.4	2.1	2.6	2.1	13.6	9.3	4.4	6.0
5909 % diff						0.00	2.56	21.21	50	100	5.26	2.60	2.74	1.11	6.64	5.12	2.02
5912 % diff						3.23	2.56	9.09	0	100	1.32	12.34	1.22	7.80	4.90	8.43	2.02
3105 % diff						0.00	8.97	100.00	100	200	4.61	3.90	11.25	2.45	4.43	5.42	1.35
1412 % diff						0.00	3.85	81.82	50	100	7.89	0.65	5.17	6.46	5.01	2.11	1.01
41017 % diff						3.23	10.26	100.00	100	100	8.55	10.39	2.43		2.10	6.63	2.36
Average % diff						1.3	5.6	62.4	60.0	120.0	5.5	6.0	4.6	4.5	4.6	5.5	1.8

T T ID	ID	SiO2	TiO2	Al2O3	TFe2O3	FeO	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	Total		
5909	NOP-ECP	75.73	0.25	12.74	1.48	0.23	1.23	0.07	0.14	0.34	1.1	6.53	0.07	2.45	100.89		
5912	-WR1/2	74.75	0.26	12.75	1.64	0.32	1.29	0.05	0.16	0.48	1.04	6.43	0.07	2.74	100.35		
3105	5912	74.22	0.24	12.54	1.52			0.05	0.14	0.49	1.11	6.29	0.07	2.82	99.49		
1412	5912	74.89	0.24	12.80	1.54	0.15	1.34	0.04	0.13	0.54	1.09	6.67	0.09	2.81	100.84		
41017	5909	74.54	0.24	12.28	1.40	0.19	1.16	0.07	0.12	0.38	1.06	6.36	0.07	2.50	99.00		
Average		74.83	0.25	12.62	1.52	0.22	1.25	0.06	0.14	0.45	1.08	6.46	0.07	2.66	100.11		
STD		0.56	0.01	0.22	0.09	0.07	0.08	0.01	0.01	0.08	0.03	0.15	0.01	0.18	0.84		
5909 % diff		1.20	0.00	0.95	2.63	4.55	1.60	16.67	0.00	24.44	1.85	1.08	0.00	7.89	0.78		
5912 % diff		0.11	4.00	1.03	7.89	45.45	3.20	16.67	14.29	6.67	3.70	0.46	0.00	3.01	0.24		
3105 % diff		0.82	4.00	0.63	0.00			16.67	0.00	8.89	2.78	2.63	0.00	6.02	0.62		
1412 % diff		0.08	4.00	1.43	1.32	31.82	6.91	33.33	7.14	20.00	0.93	3.25	28.57	5.64	0.73		
41017 % diff		0.39	4.00	2.69	7.89	13.64	7.35	16.67	14.29	15.56	1.85	1.55	0.00	6.02	1.11		
Average % diff		0.5	3.2	1.3	3.9	23.9	4.8	20.0	7.1	15.1	2.2	1.8	5.7	7.1	0.7		

6/20/93

samples 5909 and 5912 are two bulk powders of NOP-ECP-1
These represent the unaltered Nopal Formation

6/20/93
BWL

Summary of Santorini Rock Chemistry

Majors santorini

Sample ID	~~Distance West (m)~~ BWL 6/20/93	SiO2	TiO2	Al2O3	TFe2O3	FeO	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	Total
1407	SAN-WMM-007	62.63	0.80	15.95	5.94	1.65	4.02	0.16	1.68	5.05	5.14	1.82	0.72	1.30	101.19
1408	SAN-WMM-008	63.21	0.77	15.68	5.61	1.74	3.61	0.16	1.52	4.14	5.19	2.09	0.24	0.52	99.12
1409	SAN-WMM-009	59.18	0.69	14.84	5.38	1.87	3.24	0.13	2.52	5.25	2.77	1.73	0.89	6.87	100.25
1414	SAN-WMM-004	56.31	0.84	16.59	7.68	3.17	4.10	0.16	3.15	7.24	3.48	1.52	0.12	1.94	99.03
1415	SAN-WMM-005	59.59	0.72	14.25	5.75	1.99	3.48	0.14	2.59	5.15	2.94	1.74	0.64	6.12	99.63

Trace santorini

Sample ID	~~Distance West (m~~ BWL 6/20/93	Sc	V	Cr	Ni	Cu	Zn	Nb	Y	Zr	Ba	Sr	Rb
1407	SAN-WMM-007	17.3	58	9	6	20	84	12	49.0	91	362	183	58
1408	SAN-WMM-008	17.2	50	6	2	10	79	10	50.6	220	377	171	63
1409	SAN-WMM-009	14.8	98	41	18	44	77	9	30.4	47	465	264	61
1414	SAN-WMM-004	25.8	199	10	18	16	74	10	31.1	138	347	226	48
1415	SAN-WMM-005	16.4	96	45	16	41	81	9	31.7	156	415	222	62

Compare these results to results of leachant study to determine the proper framework to interpret these results.

6/20/93 CWL

Summary of E-W Transect at 7.5 m North on +10m Line 13
Results for Major Elements

Sample ID	Distance West (m)	SiO2	TiO2	Al2O3	TFe2O3	Feo	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	Total
1413	2.55	76.38	0.24	12.79	0.72	0.16	0.53	0.01	0.12	0.13	0.53	6.36	0.02	2.49	99.78
41001	4.00	76.57	0.23	12.32	0.93	0.27	0.62	0.01	0.07	0.19	0.59	6.43	0.03	2.25	99.62
41003	5.20	77.98	0.25	11.93	0.60	*1.19*	*-0.68*	0.01	0.06	0.17	0.57	5.88	0.02	2.38	99.84
41004	6.20	77.28	0.24	12.37	0.48	0.24	0.21	0.01	0.06	0.16	0.53	6.05	0.04	2.48	99.69
41005	7.45	76.33	0.25	13.03	0.54	0.08	0.44	0.00	0.06	0.17	0.54	6.38	0.03	2.51	99.84
41106	8.15	76.00	0.24	13.08	0.57	0.07	0.48	0.01	0.06	0.17	0.62	6.64	0.06	2.38	99.85
41022	8.15	76.54	0.25	13.33	0.65	0.05	0.58	0.01	0.05	0.13	0.58	6.58	0.02	2.41	100.56
AVG	**8.15**	**76.27**	**0.25**	**13.21**	**0.61**	**0.06**	**0.53**	**0.01**	**0.06**	**0.15**	**0.60**	**6.61**	**0.04**	**2.40**	**100.21**
1418	9.00	77.01	0.25	13.28	0.57	0.18	0.36	0.00	0.01	0.11	0.43	5.77	0.02	2.83	100.28
1402	9.70	76.42	0.25	12.87	0.59	0.10	0.47	0.00	0.03	0.10	0.54	6.06	0.01	2.41	99.28
1421	10.30	78.25	0.23	12.65	0.57	0.08	0.47	0.00	0.02	0.07	0.31	4.77	0.02	3.12	100.02
1420	10.80	77.02	0.26	13.73	0.44	0.10	0.32	0.00	0.03	0.10	0.31	4.63	0.01	3.26	99.80
1405	11.55	77.48	0.24	13.03	0.61	0.09	0.50	0.01	0.03	0.09	0.30	4.80	0.02	2.92	99.53
1422	11.55	77.18	0.24	12.71	0.60	0.08	0.50	0.01	0.03	0.10	0.32	5.04	0.04	2.95	99.19
AVG	**11.55**	**77.33**	**0.24**	**12.87**	**0.61**	**0.09**	**0.50**	**0.01**	**0.03**	**0.10**	**0.31**	**4.92**	**0.03**	**2.94**	**99.36**
1403	11.90	75.29	0.21	9.27	4.42	0.51	3.75	0.01	0.01	0.44	0.09	1.98	0.03	4.29	96.02
1411	12.50	77.46	0.22	12.37	0.71	0.01	0.68	0.00	0.02	0.13	0.31	4.25	0.01	3.22	98.72
1401	12.95	73.11	0.19	9.19	10.52	0.06	10.15	0.01	0.01	0.14	0.18	2.83	0.01	3.42	99.60
1419	13.50	76.57	0.22	10.97	4.09	0.09	3.88	0.01	0.02	0.10	0.23	3.61	0.00	3.42	99.25
1423	13.50	76.52	0.22	11.20	4.13	0.12	3.88	0.01	0.03	0.11	0.24	3.69	0.02	3.41	99.56
AVG	**13.50**	**76.55**	**0.22**	**11.09**	**4.11**	**0.11**	**3.88**	**0.01**	**0.03**	**0.11**	**0.24**	**3.65**	**0.01**	**3.42**	**99.41**
1416	13.95	59.95	0.15	8.56	26.01	0.31	24.92	0.01	0.01	0.14	0.06	0.97	0.01	4.72	100.60
1425	13.95	60.22	0.15	8.47	24.72	0.23	23.76	0.01	0.02	0.15	0.07	0.99	0.02	4.72	99.54
AVG	**13.95**	**60.09**	**0.15**	**8.52**	**25.37**	**0.27**	**24.34**	**0.01**	**0.02**	**0.15**	**0.07**	**0.98**	**0.02**	**4.72**	**100.07**
41008	14.45	79.43	0.25	10.81	2.39	0.16	2.15	0.01	0.05	0.15	0.25	3.27	0.04	3.43	100.07
41023	14.45	78.91	0.24	10.60	2.38	0.16	2.14	0.01	0.04	0.07	0.23	3.17	0.04	3.53	99.21
AVG	**14.45**	**79.17**	**0.25**	**10.71**	**2.39**	**0.16**	**2.15**	**0.01**	**0.05**	**0.11**	**0.24**	**3.22**	**0.04**	**3.48**	**99.64**
41009	15.00	74.66	0.22	10.97	6.56	0.09	6.27	0.01	0.05	0.19	0.26	3.38	0.03	3.71	100.05
41010	15.60	66.17	0.29	16.09	8.25	0.16	7.84	0.01	0.05	0.19	0.14	1.55	0.07	7.08	99.88
41011	16.40	74.95	0.21	11.24	6.90	0.13	6.56	0.00	0.03	0.10	0.14	2.13	0.02	4.22	99.93
1406	17.00	73.00	0.23	15.37	3.33	0.12	3.11	0.00	0.01	0.09	0.11	1.67	0.02	6.56	100.38
41013	17.40	71.77	0.20	15.45	3.25	0.13	3.02	0.00	0.04	0.06	0.06	0.55	0.01	8.21	99.60

Sample ID	Distance West (m)	SiO2	TiO2	Al2O3	TFe2O3	Feo	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	Total
41014	18.05	71.68	0.19	12.94	6.16	0.18	5.79	0.00	0.01	0.04	0.04	0.64	0.01	7.42	99.13
41024	18.05	72.02	0.20	13.19	6.52	0.20	6.12	0.00	0.03	0.06	0.06	0.65	0.01	7.49	100.21
AVG	**18.05**	**71.85**	**0.20**	**13.07**	**6.34**	**0.19**	**5.95**	**0.00**	**0.02**	**0.05**	**0.05**	**0.65**	**0.01**	**7.46**	**99.67**
41015	18.35	72.72	0.21	14.11	0.77	0.17	0.57	0.00	0.02	0.05	0.06	1.58	0.01	10.74	100.28
41016	18.60	74.47	0.22	14.61	0.64	0.15	0.46	0.00	0.02	0.07	0.07	0.89	0.02	8.33	99.33
41018	19.00	78.20	0.22	10.83	0.94	0.23	0.67	0.01	0.07	0.06	0.11	1.07	0.02	8.16	99.67
41019	19.65	74.18	0.21	12.45	1.37	0.23	1.09	0.00	0.08	0.07	0.06	1.32	0.01	9.31	99.08
41020	20.10	74.32	0.23	14.13	1.54	0.16	1.33	0.00	0.04	0.06	0.08	1.48	0.03	8.22	100.13
41021	20.65	77.55	0.24	12.29	0.56	0.14	0.40	0.00	0.04	0.06	0.20	2.82	0.04	6.08	99.90
41025	20.65	77.20	0.25	12.25	0.56	0.13	0.41	0.00	0.04	0.06	0.19	2.72	0.03	6.12	99.42
AVG	**20.65**	**77.38**	**0.25**	**12.27**	**0.56**	**0.14**	**0.40**	**0.00**	**0.04**	**0.06**	**0.20**	**2.77**	**0.04**	**6.10**	**99.66**

Call Melanie Barnes to check FeO/Fe2O3 ratios on 41xxx series samples.

6/20/93 Summary of Minoan (trace) Elements Results for BWL E-W Transect at 7.5 m North on +10m Level

E-W Transect summary Trace

Sample ID	Distance West (m)	Sc	V	Cr	Ni	Cu	Zn	Nb	Y	Zr	Ba	Sr	Rb
1413	2.55	3.3	20	8	23	2	113	36	38.9	241	72	31	341
41001	4.00	3.8	24			3	130	35	35.3		74	22	360
41003	5.20	3.6	18			2	117	32	33.9		68	33	324
41004	6.20	4.0	25			2	101	35	34.3		70	41	318
41005	7.45	4.8	31			1	105	35	40.4		75	32	357
41106	8.15	3.0	27			1	125	41	35.5		66	64	368
41022	8.15	3.1	26			4	112	41	34.7		68	64	347
AVG	**8.15**	**3.1**	**27**			**3**	**113**	**41**	**35.1**	**0**	**67**	**64**	**358**
1418	9.00	4.4	56	5	9	5	88	36	77.4	305	85	33	300
1402	9.70	3.1	19	4	7	4	87	30	36.9	256	69	38	338
1421	10.30	2.6	64	7	18	5	140	35	33.3	243	128	52	245
1420	10.80	3.5	44	8	14	4	132	36	37.6	258	82	51	245
1405	11.55	1.6	169	7	8	18	312	33	41.7	249	119	43	245
1422	11.55	1.6	171	6	11	19	213	35	41.3	231	115	41	242
AVG	**11.55**	**1.6**	**170**	**7**	**10**	**19**	**213**	**34**	**41.5**	**240**	**117**	**42**	**244**
1403	11.90	4.4	184	40	13	45	870	50	77.4	291	397	100	81
1411	12.50	1.7	29	12	16	7	182	27	25.4	215	85	57	228
1401	12.95	2.5	87	10	3	12	206	19	31.4	257	492	49	137
1419	13.50	2.4	92	2	0	10	212	36	15.7	219	126	62	170
1423	13.50	2.4	93	4	5	11	232	34	17.3	219	126	61	168
AVG	**13.50**	**2.4**	**93**	**3**	**3**	**11**	**222**	**35**	**16.5**	**219**	**126**	**62**	**169**
1416	13.95	7.7	317	14	53	31	1000	24	56.5	539	241	54	41
1425	13.95	7.8	332	6	3	28	1000	24	54.4	508	251	55	42
AVG	**13.95**	**7.8**	**325**	**10**	**28**	**30**	**1000**	**24**	**55.5**	**524**	**246**	**55**	**42**
41008	14.45	3.0	74			6	190	52	16.9		125	62	144
41023	14.45	2.4	77			6	189	42	17.4		129	66	136
AVG	**14.45**	**2.7**	**76**			**6**	**-6**	**47**	**17.2**	**0**	**127**	**64**	**140**
41009	15.00	2.6	127			9	285	41	16.3		105	57	156
41010	15.60	13.2	332			22	374	37	43.0		294	231	67
41011	16.40	3.6	75			6	64	30	12.4		130	62	96
1406	17.00	9.4	60	36	69	9	30	32	11.9	213	144	118	59
41013	17.40	12.2	138			8	98	31	11.9		227	158	10
41014	18.05	15.8	116			6	37	30	11.1		519	292	10
41024	18.05	15.6	114			6	26	31	10.8		530	297	9
AVG	**18.05**	**15.7**	**115**			**6**	BWL 6/20/93	**31**	**11.0**	**0**	**525**	**295**	**10**

Sample ID	Distance West (m)	Sc	V	Cr	Ni	Cu	Zn	Nb	Y	Zr	Ba	Sr	Rb
41015	18.35	36.8	124			4	37	38	12.1		451	362	12
41016	18.60	28.7	133			4	36	35	10.9		233	190	12
41018	19.00	26.7	112			6	42	36	11.9		409	177	14
41019	19.65	24.9	142			11	57	34	12.4		345	287	16
41020	20.10	18.6	191			8	56	35	11.0		292	194	39
41021	20.65	15.3	104			5	29	40	13.8		170	146	103
41025	20.65	15.7	105			5	22	38	13.7		159	148	105
AVG	**20.65**	**15.5**	**105**			**5**	**26**	**39**	**13.8**	**0**	**165**	**147**	**104**

6/20/13
BWL

Summary of Majors and Minors (Trace) Element Analyses for 2 meter traverse at 9.1 m North and +10 m level of Nopal I.

Majors 2m E-W at 9.1 m N

Sample ID	Distance West (m)	SiO2	TiO2	Al2O3	TFe2O3	FeO	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	Total
1901	11	76.59	0.24	12.02	1.34	0.16	1.13	0.01	0.04	0.09	0.28	4.50	0.06	3.50	98.66
1905	11.22	76.31	0.27	13.04	2.45	0.15	2.22	0.01	0.06	0.09	0.16	3.19	0.04	4.53	100.14
1907	11.4	73.99	0.26	14.10	1.14	0.11	0.99	0.01	0.04	0.08	0.30	5.18	0.05	4.03	99.17
1909	11.6	77.97	0.20	8.97	5.66	0.15	5.34	0.01	0.01	0.11	0.13	2.27	0.06	4.00	99.38
1903	11.78	76.86	0.21	10.22	4.69	0.29	4.25	0.01	0.02	0.11	0.15	2.99	0.06	3.82	99.14
1911	11.78	77.47	0.21	9.92	4.61	0.23	4.23	0.01	0.02	0.10	0.15	2.89	0.06	3.79	99.24
AVG	**11.78**	**77.17**	**0.21**	**10.07**	**4.65**	**0.26**	**4.24**	**0.01**	**0.02**	**0.11**	**0.15**	**2.94**	**0.06**	**3.81**	**99.19**
1913	12	71.94	0.18	12.78	6.19	0.21	5.79	0.01	0.05	0.17	0.11	1.98	0.04	5.84	99.29
1914	12.18	77.27	0.22	10.07	3.95	0.30	3.52	0.01	0.02	0.12	0.15	2.83	0.11	4.64	99.39
1910	12.42	77.46	0.24	11.17	2.53	0.15	2.30	0.01	0.02	0.12	0.21	3.47	0.03	4.02	99.27
1908	12.65	79.08	0.24	10.88	1.62	0.12	1.45	0.01	0.03	0.13	0.23	4.02	0.05	3.49	99.77
1915	12.65	78.57	0.24	11.23	1.71	0.11	1.54	0.01	0.03	0.14	0.24	4.16	0.02	3.49	99.82
AVG	**12.65**	**78.83**	**0.24**	**11.06**	**1.67**	**0.12**	**1.49**	**0.01**	**0.03**	**0.14**	**0.24**	**4.09**	**0.04**	**3.49**	**99.80**
1906	12.87	76.92	0.22	11.72	1.63	0.12	1.46	0.01	0.02	0.09	0.30	4.59	0.01	3.27	98.78
1902	13	74.93	0.22	11.45	3.91	0.08	3.71	0.01	0.02	0.10	0.32	4.84	0.04	3.29	99.12

Trace 2m E-W at 9.1 m N

Sample ID	Distance West (m)	Sc	V	Cr	Ni	Cu	Zn	Nb	Y	Zr	Ba	Sr	Rb
1901	11	3.0	73	5	1	11	355	35	33.5	257	188	71	217
1905	11.22	3.4	114	12	24	19	435	41	45.4	293	208	94	137
1907	11.4	2.3	46	5	6	10	239	39	37.4	258	75	66	253
1909	11.6	12.3	171	4	4	43	1900	32	275.1	554	310	82	96
1903	11.78	9.6	175	5	2	40	1351	33	118.5	491	331	93	133
1911	11.78	8.9	149	4	7	37	1155	33	119.8	458	300	84	132
AVG	**11.78**	**9.3**	**162**	**5**	**5**	**39**	**1253**	**33**	**119.2**	**475**	**316**	**89**	**133**
1913	12	12.9	173	4	3	38	2335	30	100.6	515	265	69	87
1914	12.18	10.0	128	7	5	16	807	35	81.4	511	410	219	123
1910	12.42	3.0	79	42	70	9	645	30	22.0	275	137	62	161
1908	12.65	2.4	52	16	26	4	364	31	15.8	248	145	63	185
1915	12.65	2.6	51	6	3	3	375	31	15.7	248	153	68	184
AVG	**12.65**	**2.5**	**52**	**11**	**15**	**4**	**370**	**31**	**15.8**	**248**	**149**	**66**	**185**
1906	12.87	2.0	28	10	6	0	162	24	18.9	213	586	52	247
1902	13	1.4	36	8	1	0	196	20	21.2	222	616	42	243

6/20/93
BWL

Acceptance of Texas Tech Whole-Rock Analyses

A January 23, 1991 memo from R.D. Brient to the Center Qualified Suppliers List gives the acceptance criteria currently in effect for geochemical data at the Center.

Some of the analyses provided in these batches of samples do not meet the criterion in the Brient memo, nevertheless, the analyses do have scientific usefullness and will not be summarily discarded.

Major Elements (>1 wt%)

Analyses for FeO (on standards G-2, STM-1, & BHVO-1), Fe_2O_3 (calculated from TFe_2O_3 & FeO) (on standards G-2, STM-1, BHVO-1, W-2, and AGV-1 and duplicates 1908/1915 and 41014/41024), TFe_2O_3 (duplicates 1908/1915 and 41014/41024), CaO (standards STM-1, RGM-1), Na_2O (standards STM-1 & BHVO-1) and K_2O (standards RGM-1 and duplicates 1405/1422) fail to meet the Brient Memo criteria because the abundances of each oxide are just over 1 wt% and are therefore subject to a maximum 5% variance in any standard or duplicate analysis.

This explaination is appropriate for the CaO analysis, however, this is not the case for other "elements"

Problems with FeO with precision and accuracy require further analysis before summarily rejecting all analyses of FeO. First, it is important to note that the Texas Tech Lab can measure the difference between 1.2, 1.4, 2.0, and 8.0 wt% FeO where errors (variance is <10%) for analyses over 1 wt% FeO. It is equally clear that for values < 1 wt% FeO, variances can be up to 30% but the absolute differences for duplicate samples only range from 0.01 - 0.08 wt%.

6/21/93
BWL

Again Texas Tech can tell the difference between values around .1 and .2 wt% FeO and this means that the analyses have scientific value.

From perusal of the TFe_2O_3 on the standards and duplicates it is clear that error arising in Fe_2O_3 appears to be derived primarily from error in FeO analyses since Fe_2O_3 is calculated from $TFe_2O_3 - FeO \equiv Fe_2O_3$. Thus errors given in below table for FeO will be used as a conservative measure of error of Fe_2O_3 measurements.

For Na_2O the error on standard STM-1 is 5.16% (.46wt% too low and on BHVO-1 the error is less than 10%. The Texas Tech lab can tell the difference between samples 2, 4, 8 wt% Na_2O and this is scientifically meaniful. For analyses over 1 wt% Na_2O error of 10% can be assumed.

Finally for K_2O errors on RGM-1 and duplicates 1405/1422 are 5.31% and 5.0%, respectively, and are only .23 and .24 wt% too low. Again the analyst can distinguish between standards and duplicates which are 0.5, 1, 2, 3, 4 and thus the K_2O analyses retain scientific usefullness.

Reasonable uncertainties for Major Elements

	FeO	Fe_2O_3	TFe_2O_3	CaO	Na_2O	K_2O
%	10	20	<5	5	5	5

We will use these analyses, however, we will retain acute awareness of the uncertainty associated with these numbers.

6/21/93
BWL

Minor Elements (<1 wt%)

No distinction is made in the Brient Memo between "minor" elements and "trace" elements. Therefor many of these analyses fail to meet the % variance criteria because they have small absolute variances which are large % variance. For example, if a standard contained 3 ppm of X and was reported by Texas Tech to contain 2ppm of X it would have a 66% variance and, by the Brient memo criteria, be unacceptable.

We will use such data because it is scientifically meaningful and will seek to have the acceptance criteria for trace components modified appropriately.

Specifically data in these analyses for TiO_2, MnO, MgO, FeO, CaO, Na_2O, P_2O_5, Sc, V, Cr, Ni, Cu, Zn, Nb, Y, Zr, Ba & Sr falls into the above category.

BWL 6/21/93

6/21
OCL

2L OF 1.0 N HNO_3 WAS MADE BY MEASURING OUT 286 mL OF 7N HNO_3 (LOT # 913941) IN * CLEANED 100 mL AND 50 mL GRADUATED CYLINDERS. ACID POURED INTO LABELED AND CLEANED ACID BOTTLE WHERE 714 mL OF NANOPURE H_2O WAS ADDED. SOLUTION WAS MIXED AND LABELED:

1.0 N HNO_3
LOT # 913941
6/21/93 OCL

100 mL OF 10% TBP / AMYL ACETATE WAS PREPARED BY MEASURING OUT 10 mL (LOT # 911238) OF Tri-n-butylphosphate in a cleaned 10 ml GRADUATED CYLINDER AND POURING INTO AN AMBER BROWN 4L BOTTLE. 90 mL OF AMYL ACETATE (LOT # 902158) MEASURED IN A CLEANED 100 ml GRADUATED CYLINDER IS THEN POURED INTO ABOVE 4L BOTTLE & LABELED.

* NOTE: SAMPLES 1287/9.1 AND 12.42/9.14 WERE MIXED DURING FINAL H_2SO_4 EXTRACTION. 5 - 25 mL EXTRACTIONS [1 BEING SAMPLE 12.87/9.1] WAS ADDED TO 12.42/9.14 AND 12.87/9.1 WENT THROUGH 3 EXTRACTIONS OF 1 M H_2SO_4

6/22/93 pgh

Continuation of Autoradiographic Experiment (see AN-1 042/239

The samples processed for 1 hour on 6/8/93 did not show any alpha hits.

NOPI-ECP. 12.5/7.75-TS1 (RA10) & NOPI ECP 22.5/10.4-TS1 (RA13) were re-exposed to CR-39 for 2 days. The procedure used is described on page 239 & 277 of AN-1(042)

These samples were countable. An area was chosen & on NOPI-ECP. 22.5/10.4-TS1 and alpha hits within the fracture were counted using the square reticle and objective 20X.

6/22/93 pgh

SEM Analysis of the following samples was performed at DIVIS using an AMRAY 1610 SEM & Tracor Northern 5505 EDS.

NOPI-ECP. 10.16/13.5 is a calcite sample with small areas of some kind of metal oxide that has acicular crystals EDS was performed and the crystals were found to be Mn. Also found were smaller acicular crystals of iron oxide.

NOPI-ECP. 12.22/13.55 was powder that remained from a fracture sample. The grains were not fixed well & moved when exposed to the electron beam. Pictures were not taken. An EDS showed no uranium. The sample consists of Fe, S, Si and lesser amounts of K, Al, & As.

NOPI-ECP. 3.78/13.70 was also from the fracture but further away from the fracture surface. No U was found. Sample consists of Fe, Si, Al with smaller amts of Zn, As & Ca.

NOPI-ECP. 17 is a calcite sample. Pictures was taken showing homogenous layering. ~~Other~~ Closer examination did not show any obvious differences.

6/24/93 Autoradiographic Experiment

Purpose: To expose NOPI-ECP. 33-TS3 for a short period of time in order to make a count of alpha hits within the fracture.

Method, supplies & procedures are the same as found in 042/239. This sample will be allowed to set for 4 weeks.

6/24/93 pg2 Calibration of the new XRD computerized system was performed by re-running selected samples on the New system & comparing the results to previously obtain results. The analysis & summary are in a Notebook labeled XRD calibration located in Bldg 51.

6/25/93 OCL 6/16/94

6/25/95 OCL ALPHA SPECTROMETERY MEASUREMENTS ON ROCK SAMPLES IN THE NOPAL FORMATION OF PEÑA BLANCA, MEXICO HAVE BEEN AND WILL BE MEASURED. THE FOLLOWING TRAVERSES PLAN TO BE THE SAMPLE AREAS DESIGNATED:

- E/W TRAVERSE AT 7.5 N + 10 m level
- 2 meter E/W TRAVERSE TRANSECT AT 9.1 meters N + 10 m level
- FRACTURE AT 13.5 m North + 10 m level

EXPERIMENTAL PROCESS CHOSEN TO BE USED FOR THIS STUDY IS OUTLINED IN THE METHOD BY M. GASCOYNE AND J.P.A. LAROQUE ENTITLED A RAPID METHOD OF EXTRACTION OF URANIUM AND THORIUM FROM GRANITE FOR ALPHA SPECTROMETRY.

Information potentially subject to copyright protection was redacted from this location. The redacted material (an article) is from the following reference:

Gascoyne, M. and J.P.A. Larocque. "A Rapid Method of Extraction of Uranium and Thorium from Granite for Alpha Spectrometry." Amsterdam: North-Holland: Nuclear Instruments and Methods in Physics Research. Vol. 223. pp. 250-252. 1984.

EACH SAMPLE WILL BE POWDERED AND DRIED AND THE STEPS OUTLINED IN PART 4. METHOD OF GASCOYNE AND LAROQUE WILL BE FOLLOWED. EACH STEP OF THIS METHOD WILL BE RECORDED ON A DATA SHEET ALREADY PREPARED.

U/Th FUSION SAMPLE SHEET

Sample I.D. # _____

Date: _____

Analyst: _____

FUSION:

Weights: SPEX LiBO2 (Lot #_____) _____ g

Sample Powder _____ g

Drying Under Heat Lamp
Start Dry _____
Finish Dry _____

Melting in Muffle Furnace
Start Time _____
Finish Time _____
Temp. oC _____

Quenching Sample in 1 N HNO3
Volume 1.0 N HNO3 (Lot# _____) _____ ml

U-232/Th-228 SPIKE #:_____
Reference Date _____
Reference Activty _____ pCi/g
Spike Weight: _____ grams
U spec. Activity _____ dpm/g
Th/U ratio: _____

Transfer 100 ml of glass solution into labeled Nalgene bottle and proceed with solvent extraction.

SOLVENT EXTRACTION:

Weight: Al(NO3)-9H2O (Lot #_____) _____ g

10% TBP/Amyl Acetate _____ ml
(Lot #_____) (Lot #_____)

Shaken in Erlenmeyer Flask
Start Time _____ Finish Time _____
Pour into Separatory Funnel, drain inorganic to waste, and organic to new Erlenmeyer flask

Add 25 ml H2SO4 (Lot #_____)
Extract, Pour into Separatory Funnel and save H2SO4

Extraction 1	Start Time	_____	Finish Time	_____
Extraction 2	Start Time	_____	Finish Time	_____
Extraction 3	Start Time	_____	Finish Time	_____
Extraction 4	Start Time	_____	Finish Time	_____

1

U/Th FUSION SAMPLE SHEET

PLATING Continued:
Th: Date _____ Initials _____

Wash residue with < 5 ml 0.1N HNO3 (Lot #_____) ml used _____
Transfer wash with pasteur pipet to centrifuge tube
Adjust pH to 1.0 with NaOH solutions (Lot #_____)

Add 1- 2 ml 0.4 M TTA in benzene ml used _____
(Lot #_____) (Lot #_____)

FILE NAME _____
Date and time started counting _____ Initials _____
Date and time finish counting _____ Total time minutes _____

U/Th FUSION SAMPLE SHEET

Gently boil H2SO4 to dryness
Start Time _____ Finish Time _____
Heat more strongly to drive off SO3
Start Time _____ Finish Time _____

COLUMN SEPARATION:

Column Preparation:
BIO-RAD Anion Exchange Resin (Lot #_____)
AG 1-X8 100-200 mesh Chloride form

Prewash 4 cm x 1 cm column of resin with 0.1 N HCl (Lot #_____)
45 ml 0.1 N HCl and conditioned with _____ml + _____ ml + _____ml

60 ml 9 N HCL 9 N HCl (Lot #_____)
_____ml + _____ ml + _____ml+ _____ ml

Elution:

Dissolve dried residue in 9 N HCl _____ml and load on column and allow to drain

Elute Th fraction with 9 N HCl (45-60 ml) _____ml + _____ ml + _____ml

Elute U fraction with 0.1 N HCl (45-60 ml) _____ml + _____ ml + _____ml

Drying of Th eluate
Start Time _____ Finish Time _____

Drying of U eluate
Start Time _____ Finish Time _____

PLATING:
U: Date _____ Initials _____

Wash residue with < 5 ml 0.1N HNO3 (Lot #_____) ml used _____
Transfer wash with pasteur pipet to centrifuge tube
Adjust pH to 3- 3.5 with NaOH solutions (Lot #_____)
Add 1- 2 ml 0.4 M TTA in benzene ml used _____
(Lot #_____) (Lot #_____)

FILE NAME _____
Date and time started counting _____ Initials _____
Date and time finish counting _____ Total time minutes _____

ONCE ALL SAMPLE SHEETS ARE FILLED OUT, ALPHA SPECTROMETRY MEASUREMENTS COMPLETE, AND RESULTS ANALYZED, THE DATA WILL BE COLLECTED AND PLACED IN A SEPARATE BINDER ACCORDING TO WHICH AREA THE ROCK SAMPLE ORIGINATED.

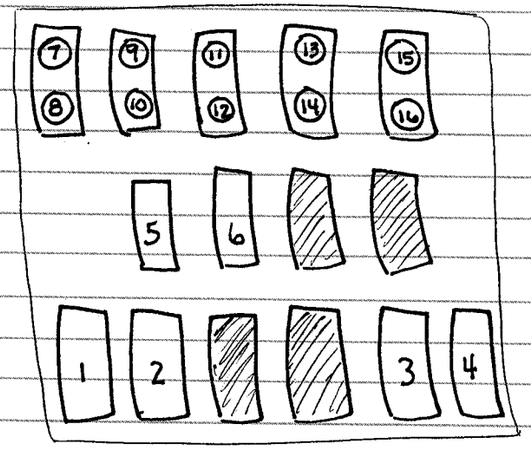
7-8-93 OCL 8/14/94

~~1-8-94~~ OCL

FOLLOWING SAMPLES HAVE BEEN PREPARED FOR ALPHA SPECTROMETRY AND ARE NOW MEASURING :

- NOPI-ECP- 13.0/9.2 - WR Thorium
- NOPI-ECP - 11.0/ 9.15 - WR Uranium
- NOPI-ECP - 11.78/9.17 - WR U & Th
- NOPI-ECP- 11.22/9.07 - WR U & Th

RECONFIGURATION OF CHANNELS HAS CHANGED LABELS ON CHANNEL NUMBERING. FOLLOWING DIAGRAM REVEALS THE NEW CONFIGURATION ON THE α SPECTROMETER



1/27/94 OCL A NEW TRAVERSE WILL BEGIN ALPHA SPECTROMETRY ANALYSIS. TAKEN FROM THE FRACTURE AT 13.5 m N + 10 m level, THE FOLLOWING SAMPLES WILL BE MEASURED :

- NOPI-ECP- 4.5/13.77 - GAM-0
- NOPI-ECP- 4.5/13.77 - GAM-1
- NOPI-ECP- 4.5/13.77 - GAM-2
- NOPI-ECP- 4.5/13.77 - GAM-3
- NOPI - ECP - 4.5/13.77 - GAM - 4
- NOPI - ECP - 4.5/13.77 - GAM - 5
- NOPI - ECP - 4.5/13.77 - GAM - 6
- NOPI - ECP - 4.5/13.77 - GAM - 7
- NOPI - ECP - 4.5/13.77 - GAM - 8
- NOPI-ECP - 4.5/13.77 - WR - GAM
- NOPI-ECP- 4.5/13.73
- NOPI - ECP - 4.5/13.66
- NOPI - ECP - 4.5/13.62
- NOPI - ECP - 4.5/13.80
- NOPI - ECP - 4.5/13.83
- NOPI - ECP - 4.5/13.86
- NOPI - ECP - 4.5/13.90

7/28
OCL

SAMPLES :

NOPI-ECP- 4.5/13.62
NOPI-ECP - 4.5/13.83
NOPI-ECP - 4.5/13.86
NOPI-ECP - 4.5/13.90

} ALL PREPARED FOR QC SPEC USING GASCOYNE AND LAROQUE METHOD

NOTE : AFTER QUENCHING, ALL SOLUTIONS HAD TROUBLE FULLY DISSOLVING. VERY CLOUDY WITH CLEAR PARTICLES ~~REMAINING~~ REMAINING AT BOTTOM.

SOLNS. HEATED & MIXED FOR 63 minutes.

* SAMPLE POWDERS MAY HAVE ~~BEEN~~ HAD OCL 7/28 TOO LARGE PARTICLES CAUSING BAD HETERGENIZING OF $LiBO_2$ + POWDER. I WILL SIFT POWDERS FROM NON ON BEFORE I BEGIN SAMPLE PREPARATION.

SOLNS. TRANSFERRED TO 600 mL beakers & volume increased to 300 mL.

extra mix-time 57 min
total time 120 min !!!

7/29

* SAMPLE NOPI-ECP- 4.5/13.90 CONTAINED LARGE AMOUNTS OF WHITISH-GREY PRECIPITATE. PROBABLY SOME SULFATE COMPOUND, THIS SOLID HAS CAUSED THE SOLN. NOT TO SEPARATE WITH THE TBP/AMYL ACETATE. I HAVE DECIDED TO ABANDON THIS SAMPLE AND STORE IT UNTIL I CAN SPEAK WITH BRET LESLIE. SAMPLES 4.5/13.62, 4.5/13.83, AND 4.5/13.86 DID CONTAIN THE PRECIP. I FOUND IN 4.5/13.90, BUT A CLEAN SEPARATION DID OCCUR AND INORGANIC WAS ELUTED WITH LITTLE PROBLEM.

8/5/93 gf

Preparation of Whole Rock Powders

The following samples consist of Fe-oxide rich material taken from an E-W trending fracture on the +10 level of the Nopal I deposit between 42 and 43 m north. The samples will be powdered and the powder used for gamma spectrometry & XRD analysis.

* all sample with * have been relabeled using the new Sample No.

* 393-8.1/43.2 *WR is a subsample of NOPI·223*WR1 393-8.1/42.3. A dark red Fe-oxide rich material - Fracture fill - noncompetent.

* 393-11.2/42.3 *WR is a subsample of NOPI·224*WR1 393-11.2/42.3. A red/black Fe-oxide fracture-filling material - noncompetent.

* 393-12.1/42.5*WR is a subsample of NOPI·225*WR1 393-12.1/42.5. A red/black Fe-oxide rich fracture-filling material-noncompetent

* 393-13.9/42.4*WR is a subsample of NOPI·226*WR1 393-13.9/42.4. A red/black Fe-oxide rich fracture-filling material-noncompetent

* 393-15.0/42.3*WR is a subsample of NOPI·227*WR1 393-15.0/42.3. A red/black Fe-oxide rich fracture-filling material-noncompetent

* 393-17.1/42.5*WR is a subsample of NOPI·228*WR1 393-17.1/42.5. A very dark red/black Fe-oxide rich fracture-filling material. Noncompetent. Some orange limonitic crust present.

These samples were dried in an oven overnight at 110°C and the powdered using the SPEX 8000 Mixer/Mill with tungsten carbide grinding vial.

8/6/93 gf After powdering the samples were weighed and placed in platic sample containers. gf

Weight of sample powders are listed below:

* 393-8.1/43.2 *WR NOPI·223*WR1	5.988 g
* 393-11.2/42.3 *WR NOPI·224*WR1	9.853 g
* 393-12.1/42.5 *WR NOPI·225*WR1	12.864 g
* 393-13.9/42.4 *WR NOPI·226*WR1	2.836 g
* 393-15.0/42.3*WR NOPI·227*WR1	7.475 g
* 393-17.1/42.5*WR NOPI-228*WR1	5.337 g

Samples were stored in a dessicator.

8/11/93 gf Gamma vials for the samples were prepared as follows

	Sample No.	wt of Vial	wt Vial + Sample	wt of Sample
NOPI·224 *GAM1	* (393) 11.2/42.3 GAM1	2.069	6.668	4.599
NOPI·223 *GAM1	* (393) 8.1/43.2 GAM1	2.061	5.571	3.510
NOPI·225 *GAM1	* (393) 12.1/42.5 GAM1	2.059	6.019	3.960
NOPI·226 *GAM1	* (393) 13.9/42.4 GAM1	2.086	4.423	2.337
NOPI·227 *GAM1	* (393) 15.0/42.3 GAM1	2.069	5.957	3.888
NOPI·228 GAM1	* (393) 17.1/42.5 GAM1	2.060	6.072	4.012

8/16/93 pgh

Autoradiographic Experiment started on 6/24/93 was processed (using the procedures used in previous experiments) on 7/7/93. The results were very poor. The alpha hits were not concentrated enough to count.

The experiment was restarted on 8/16/93 and the slide - DOPI-ECP · 33 - TS3 will be allowed to remain in contact with the CR-39 for 3 weeks.

8/16/93

XRD samples were prepared by sieving to < 45 μ the whole rock samples of the following

(393) 8.1/43.2	-XRD1	DOPI · 223 * XRD1
(393) 11.2/42.3	-XRD1	DOPI · 224 * XRD1
(393) 12.1/42.5	-XRD1	DOPI · 225 * XRD1
(393) 13.9/42.4	-XRD1	DOPI · 226 * XRD1
(393) 15.0/42.3	-XRD1	DOPI · 227 * XRD1
(393) 17.1/42.5	-XRD1	DOPI · 228 * XRD1

(PLANTS)

8/23

SAMPLES TAKEN FROM THE NODAL I URANIUM DEPOSIT ON THE LAST TRIP HAVE BEEN DRIED AT 100°C FOR THREE DAYS AND ALLOWED TO SIT IN THE DRYER UNTIL THIS PROCEDURE WAS FINALIZED BY BRET LESLIE. THESE PLANTS ARE CONTAINED IN TWO PLASTIC ~~DR~~ TRAYS. SINCE SAMPLES ARE ALREADY SEPARATED ~~INTWO~~ INTO TWO GROUPS, I WILL LABEL ONE SAMPLE GROUP A - WASHED AND THE OTHER B - UNWASHED. THE SAMPLES ARE WEIGHED ON A BALANCE.

OCL 8/23

	MASS (g)
SAMPLE GROUP A :	140.95
SAMPLE GROUP B :	212.60

TOTAL MASS: 353.55 g

SAMPLE GROUP B WILL CONTINUE WITH PREPARATION FOR GAMMA SPECTROMETRY MEASUREMENTS WHILE SAMPLE GROUP A WILL WAIT. FOUR PREWEIGHED 50 mL PORCELAIN CRUCIBLES WILL BE FILLED WITH THE PLANT SAMPLES. PLACING THE LABELED SAMPLES INTO THE FURNACE AND PROGRESSIVELY RAISING THE TEMPERATURE TO 450°C FOR 12 HOURS WILL ASH THE SAMPLES.

(SAMPLE LABEL WILL BE DONE AS FOLLOWS:)

PR - B - (# SAMPLE)

PHACELIA ROBUSTA

PR-B-1 (LEAVES + STEM FROM 1 MAIN BRANCH)

WT. SAMPLE + CRUCIBLE 38.906 g
WT CRUCIBLE - 33.654 g
WT. SAMPLE 5.252 g

PR-B-2 (LEAVES + STEM FROM LARGE CLUSTER OF BRANCHES)

WT. SAMPLE + CRUCIBLE 45.84 g
WT. CRUCIBLE - 33.995 g
WT. SAMPLE 11.845 g

PR-B-3 (LEAVES ONLY)

WT. SAMPLE + CRUCIBLE 36.52 g
WT. CRUCIBLE - 29.666 g
WT. SAMPLE 6.854 g

PR-B-4 (STEMS ONLY)

WT. SAMPLE + CRUCIBLE 37.91 g
WT. CRUCIBLE - 28.815 g
WT. SAMPLE 9.095 g

SAMPLE GROUP A WILL NOW BE PREPARED FOR GAMMA SPECTROMETRY. THE PLANTS WILL BE "DUNKED IN A 4L BEAKER FULL OF NANOPURE H_2O AND DRIED AT 100°C.

8/24/93

Prepare Whole Rock Powders

Samples consist of Fe-oxide rich material from fractures on +10 level. Samples will be powdered for gamma spectrometry & XRD analysis

393-10-28/5 *WR is a subsample of 393-10-28/5. Brown-orange material, fairly competent (may have some cement), limonitic in appearance. From a vertical fracture on +10 level.

NOP1.229*WR1

393-10-14/6 *WR is a subsample of 393-10-14/6. Brown-black material, fairly competent, some yellow-orange limonite material covering outside. From a vertical fracture on +10 level.

NOP1.230*WR1

The following samples are from the E-W fracture at 13.5 m North on the +10 level.

793-~~(10.0)~~ 10.0 ft /13.5 *WR is a subsample of 793-~~(10.0)~~ 10.0 ft /13.5. Brown-orange material, competent, limonitic in appearance. Layering

NOP1.303*WR1

NOP1.301*WR1

793-6.1/14.0*WR is a subsample of 793-6.1/14.0. Black-red-orange Fe-oxide material. Hematite/limonite. Fairly competent. Limonite material appears to occur on surface of rock.

NOP1.302*WR1

793-8.4/13.8*WR is a subsample of 793-8.4/13.8. Dark brown-red-orange material. Competent. Limonite material on surface of darker (red-brown) material. Layering

NOP1.300*WR1

793-4.6/13.8*WR is a subsample of 793-4.6/13.8. Orange-brown Layered material. Friable limonite in appearance.

NOP1*294*WR1

793-(-10.07)/14.7*WR is a subsample of 793-(-10.07)/14.7. Black-red-orange iron oxides. Very competent fracture fill material. Limonite cavity hematite.

NOP1.298*WR1

793-(-12.2)/15.17*WR. Black-red Fe-oxides. Very competent fracture fill. This is a subsample of 793-(-12.2)/15.17

NOP1.296*WR1

793-(-11.23)/14.91*WR is a subsample of 793-(-11.23)/1491. Dark red-brown black fracture filling iron oxides. Slightly competent.

NOP1.295*WR1

793-(-11.07)/1475*WR is a subsample of 793-(-11.07)/14.75. Dark red-black fracture filling iron oxides. Very competent.

NOP1.299*WR1

793-(-13.1)/15.2*WR is a subsample of 793-(-13.1)/15.2. Black-red competent iron oxides lining fractures.

NOP1.297*WR1

793-(-11.81)/1495*WR is a subsample of 793-(-11.81)/14.95. Black iron oxides covered by limonite. Black material is very competent.

OCL 8-25

REFERRING BACK TO PAGES 35-36, SAMPLE GROUPS A AND B CONTINUE PREPARATION FOR GAMMA SPECTROMETRY MEASUREMENTS. SAMPLE GROUP B FINISHED ASHING AND WAS REWEIGHED:

FR-B-1	WT. CRUC. + SAMPLE BEFORE ASHING	38.90
	WT. CRUC. + SAMPLE AFTER ASHING	34.30
	MASS CHANGE	4.604
FR-B-2	WT. CRUC. + SAMPLE BEFORE ASHING	45.8
	WT. CRUC. + SAMPLE AFTER ASHING	35
	MASS CHANGE	10.3
FR-B-3	WT. CRUC. + SAMPLE BEFORE ASHING	36.5
	WT. CRUC + SAMPLE AFTER ASHING	30.4
	MASS CHANGE	6.05
FR-B-4	WT. CRUC. + SAMPLE BEFORE ASHING	37
	WT. CRUC. + SAMPLE AFTER ASHING	29
	MASS CHANGE	7.9

SAMPLE GROUP A MASS AFTER DRYING: 138.11 g

EACH SAMPLE WAS CRUSHED IN A MORTAR AND PESTLE THEN COMPACTED INTO LABELED GAMMA SPECTROMETRY VIALS. FOLLOWING DATA SHOW MASSES OF SAMPLE + VIAL, VIAL, & SAMPLE.

MADE ON 8/24/93 by OCL		MASS VIAL + SAMPLE	MASS VIAL	MASS SAMPLE
	FR-B-1	2.774	2.043	.731 g
	" "-2	3.428	2.196	1.232 g
	" "-3	2.930	2.008	.922 g
	" "-4	3.202	1.998	1.204 g

INSTRUCTED by BRET LESLIE, ~~THE FOLLOWING~~ cd 8/25 SAMPLE SEPARATES WILL BE PREPARED FOR ALPHA SPECTROMETRY. I WILL FOLLOW THE "URANIUM SERIES ISOCHRON DATING OF CARBONATES" OUTLINED BELOW:

Uranium series isochron dating of carbonates (calcite/caliche)

A. Sample preparation:

1. Obtain sample by carefully choosing areas which are relatively free of detrital contamination. This is done by first choosing an appropriate bulk rock sample and crushing the rock into particles containing the mineral. For calcite samples, the mineral is relatively soft and should be gently crushed and picked up using metal tweezers.

2. Sample custody log forms will be completed both for the calcite mineral particles and the unwanted particles, which will be placed into a labeled glass vial.

3. Once an adequate amount of calcite is obtained (> 1 gram), the calcite is rinsed with nanopure water and transferred into a larger glass beaker, and placed into the ultrasonicator. Any unwanted particles, such as silicates, will float to the top and be decanted out into the sink. This is continued until the sample is free of residue particles (use microscope). The sample is then placed into the Thermolyne oven for twenty-four hours at 100 degrees Celcius. The sample is finally crushed in an agate mortar and pestle, and stored in a labeled glass vial.

4.. Place and weigh 1- 10 grams (total dpm >5) into porcelain or platinum crucible. Assume that the activity of each sample is 8 dpm/g.

6. Place crucible into muffle furnace and heat at 850 ^{o}C for at least 4 hours.

7. Allow to cool to about 100 ^{o}C in furnace and then place in dessicator to finish cooling.

8. Reweigh sample.

B. Sample dissolution

1. Transfer the sample with a minimum amount of ultrapure water (squirt bottle) to a labeled (magic marker) 250.teflon beaker.

2. Add 75 ml 0.1 N HNO_3 to the beaker.

3. Concentrated HNO_3 is added to the sample until the pH = 1-2. The approximate amount needed is determined by calculation from the weight of the CaO present.

4. If all the sample is solubilized (pure carbonates) skip to **section C**, otherwise proceed with the following steps.

5. Take sample to near dryness on the hot plate (setting 5-6).

6. Remove sample from hot plate.

6. Add 50 mls HF, using a plastic beaker, and 5 ml $HClO_4$.

7. Cover beaker with teflon and put on hot plate and evaporate until $HClO_4$ fumes.
8. Repeat steps 6 and 7 if residue remains.

9. After dissolution add 50 ml aqua regia (3 conc. HCL: 1 conc.HNO_3).

10. Gently heat solution (2 or 3 on hot plate) for 1 hour and then raise hot plate setting (5 or 6) and take solution to near dryness (< 10 ml).

11. Carefully add 25-50 ml ultrapure water.

C. Spiking and coprecipitation

1. Add 1 ml (25 mg) of clean Fe carrier using Eppendorf fixed volume pipet and disposable tips. This is unnecessary for samples with large detrital silicate fractions (Fe- containing). Homogenize sample after addition of carrier by replacing lid and swirling the centrifuge tube.

2. Add an amount of the $^{232}U/^{228}Th$ spike (17A-1A) which is comparable to the expected U activity of the sample. Record the total amount of spike used in the Radioactive Log Book.

3. The spike is added by mass, utilizing a clean pasteur pipet and a tared weighing boat (spike mass recorded) and is transfered quantitatively to the sample beaker using 0.1 N HNO_3 from a squirt bottle. The used pipet is discarded in the radioactive waste container.

4. Allow the spike sample solution to equilibrate by gently heating on the hot plate until about 10 ml of the solution has evaporated.

5. Allow the solution to cool. Start step D1 now and continue with step D2 simultaneously with the following steps of C (C5 - C7) so

that once you have completed step C7 you can immediately proceed with step D3. Bring the pH up to 7 with the addition of concentrated NH_4OH from the reagent bottle. This is strongly exothermic and the solution should be gently swirled or stirred with a glass stirring rod during the addition of the base. If a glass rod is used, after stirring, rinse the rod into the beaker with ultrapure water and set the rod aside

6. The solution can then be centrifuged (labeled 50 ml centrifuge tubes) and the supernate is discarded.

7. The $Fe(OH)_3$ precipitates are washed with ultrapure water and agitated using the hand homogenizer, centrifuged and washings discarded. This step is repeated once. This is necessary to get rid of the excess NH_4.

D. Uranium-thorium separation

1. Prepare a labeled (Sample ID) anion ion exchange column (8 -10 cm high, 1 cm diameter) by placing a glass wool plug in the bottom of the column and adding a slurry (in ultrapure water) of Dowex 1 x 8 100-200 mesh chloride form ion exchange resin. Use the teflon column holders and collect the waste liquid in a plastic beaker (100 ml of greater).

2. Add 30-40 mL of 8N Ammonium Nitrate - 0.1 N Nitric acid into anion exchange column and elute into plastic waste beaker.

3. The samples will be lowered to pH =1 using 250 ml of 1.0 N HNO_3 and diluting to 5.0 ml with 0.1 N HNO_3 using squirt bottle (for each each 2.5 ml of ppt). Make sure $Fe(OH)_3$ is entirely dissolved (agitate) prior to adding the ammonium nitrate. Next, saturate the solution with 5.9 g of ammonium nitrate (for each each 2.5 ml of ppt) and shake until all is dissolved. This reaction is highly endothermic.

4. Add the sample into the column and elute Fe into a plastic beaker (250 ml) using 80 ml, added in 20 ml increments using squirt bottle, of 8 N NH_4NO3 - 0.1 N HNO_3. Rinse the centrifuge tube with the 20 ml aliquot and pour onto column and mark the level of the fluid. Test for the presence of Fe after 70 and 80 ml have eluted by placing a drop of NH_4CSN on the convex side of watch glass and allowing a drop of the eluate to come in contact with ammonium cyanide. If Fe is present then the solution will turn red. Continue to eluate the Fe until there is no red upon testing for Fe. Empty the contents of the 100 ml plastic beaker into a waste beaker.

5. Next add 100 ml, in 20 ml aliquots, of 8 N HCL acid and elute the thorium into a labeled and acid washed cleaned 100 mL glass beakers. Put solution on hot plate to reach near dryness.

6. Add no more than 5 mL of 0.1 N Nitric acid and drain into waste beaker. Next, add 50 mL of 0.1 N Nitric acid in 25 mL increments and drain the Uranium into a labeled and acid washed cleaned 100 mL glass beaker. The solution is then placed on a hot plate to reach near dryness.

E. Solvent extraction and plating

1. A total of 4 pasteur pipets are used in the following steps and it is imperative to keep them separate by labeling the rubber bulbs used with them. The dried U eluate is taken up with two ml of 0.001 N HNO_3 (pH 3) issued from a squirt bottle. Using a new pasteur pipet (W on bulb) carefully and completely wash the beaker with the acid. Transfer the acid solution to a labeled glass 12 ml centrifuge tube. Repeat this step twice more with 0.5 - 1 ml of the acid.

2. Add two drops of Methyl Orange indicator solution using a pasteur pipet (MO on bulb) to solution in centrifuge tube. Bring pH up to 3.0 with dilute 0.1 N NaOH solution using a pasteur pipet (NaO on bulb) by adding a few drops at a time and homogenizing the contents of the tube with pasteur pipet used to transfer the U eluate (W on bulb). The color should change from pink to slightly orange. The colors can be seen in test tube set which covers the pH range. If steps in D were done properly the total volume should be 5-6 ml.

3. Add 1-2 ml of the 0.4 M TTA in benzene solution to the centrifuge tube.

4. Homogenize and extract the U using the same pasteur pipet used in step E1 (W on bulb). The TTA solution should be red or orange (depending on U concentration) and this should be quickly evident (within 30 seconds to 1 minute).

5. Solution is centrifuged for 1-2 minutes, making sure that the tube is covered with Parafilm.

6. Carefully clean 2 stainless steel planchets and label them with a sharp pointed object. The label should have sample ID, date, initials of the person plating and U or Th. Label a glassine stamp envelope with the same information. The mounting ring should be on the hot plate and the hot plate should be set to red mark (~3). Place the plate, labeled side down, on the mounting ring just prior to next step.

7. The TTA solution is carefully separated using a clean pasteur pipet (P on bulb), taking care not to include any of the HNO_3 solution. This is most easily accomplished by slightly tilting the tube so that the TTA bulges on top of the acid. A total of two aliquots using the pasteur pipet (P on bulb) are used to retrieve all the TTA.

8. The TTA is evaporated drop-wise on heated steel plates that have been placed on mounting ring, making sure that spattering is avoided.

9. Remove the plate from the mounting ring and repeat the TTA extraction (Steps 3 - 8).

10. Pass the plate through the flame of a propane flame inside the fume hood to burn off the organic deposit. Allow the plate to cool on the edge of the hot plate.

11. Place plate in labeled glassine stamp envelopes and count samples ASAP after plating, recording the channel in which the sample is counted on the envelope.

12. The dried Th eluate is taken up with three mls of 0.1 N HNO_3 (pH1) issued from a squirt bottle. Using a new pasteur pipet carefully and completely wash the beaker with the acid. Transfer the acid solution to a glass centrifuge tube (7 or 12 mls). Repeat this step twice more with 1 ml of the acid.

11. Repeat steps 3-9 twice, making sure that pH1 nitric is used during the extraction.

12. Pass the plate through the flame of a propane flame inside the fume hood to burn off the organic deposit. Allow the plate to cool on the edge of the hot plate.

13. Place plate in labeled glassine stamp envelopes and count samples ASAP after plating, recording the channel in which the sample is counted on the envelope.

F. Cleaning up

1. The solution remaining in the centrifuge tube should be placed into a glass waste beaker. The centrifuge tube should be rinsed with 0.1 N HNO_3 and the rinse should also be placed into the waste beaker.

This beaker should remain inside the fumehood. The volume of the solution should be reduced by gentle heating until dry.

2. The used anion exchange resin should be rinsed with water from a squirt bottle into the used resin bottle (see instructions above).

3. All glassware should then be washed using alconox. The glassware should be rinsed with the single pass water. The glassware is then ready for the fuming nitric acid bath.

OCL

MINERAL SEPARATES NOPI-PI-OBI4 AND NOPI-PI-C23 (URANOPHANE) AND AN OPAL SEPARATE WILL BE THE SAMPLES I WILL MEASURE ON ALPHA SPECTROMETRY. SAMPLES ARE FIRST DRIED AND PLACED IN A DESSICATOR

OCL 8/26

SAMPLE GROUP A (p. 40) HAVE BEEN ASHED IN THE FURNACE FOR OVER 12 HOURS AND NOW ARE ALLOWED TO COOL. FOLLOWING DATA SHOWS THE MASS OF THE CRUCIBLE + SAMPLE BEFORE AND AFTER ASHING AND THE CHANGE IN MASS OF EACH SAMPLE:

	MASS CRUC + SAMPLE AFTER DRYING (g)	MASS CRUC. + SAMPLE BEFORE DRYING (g)	CHANGE IN MASS
FR-A-1	31.993	38.015	
FR-A-2	34.501	45.330	
FR-A-3	30.668	35.23 g	
FR-A-4	33.950	37.500 g	

MINERAL SEPARATES OF OPAL AND URANOPHANE (NOPI-PI-OB14, NOPI-PI-C23) ARE WEIGHED:

OCL 8/28 ~~OPAL~~ OCL 8/26

	MASS SAMPLE	MASS DISH	MASS SAMPLE + DISH
OPAL	.02067 g	16.85165 g	16.872[32] g
NOPI-PI-OB14	.00032 g	18.05[218] g	18.05250 g
NOPI-PI-C23	.00660 g	18.84[191] g	18.84851 g

8/26/93 PL

XRD Analysis was performed on the following samples. The New Sample No. is given and all XRD Analysis reflects the New No.

NOPI-137 * XRD1
NOPI-140 * XRD1
NOPI-143 * XRD1
NOPI-145 * XRD1
NOPI-204 * XRD1
NOPI-207 * XRD1
NOPI-211 * XRD1

8/26/93

Gamma vials were prepared for the following samples:

Sample No	Vial	Vial + Sample	Sample Wt.
NOPI-229 * GAM1	2.049	5.772	3.723 g
NOPI-230 * GAM1	2.085	5.581	3.496 g
NOPI-259 * GAM1	2.063	2.760	0.643 g
NOPI-296 * GAM1	2.068	7.577	5.509 g
NOPI-295 * GAM1	2.077	5.807	3.730 g
NOPI-303 * GAM1	2.051	6.478	4.427 g
NOPI-301 * GAM1	2.074	6.071	3.997 g
NOPI-302 * GAM1	2.064	6.512	4.448 g
NOPI-300 * GAM1	2.069	6.492	4.423 g

OCL 8/27

MINERAL SEPARATE SUBSAMPLES OPAL, NOPI-PI-OB14, AND NOPI-PI-C23 WERE DRIED IN THE FURNACE AT 850°C FOR 4 HOURS. THEY WERE COOLED AND WEIGHED. FOLLOWING DATA SHOWS THE NEW WEIGHT AND CHANGE IN MASS:

OCL 8/27 94

	BEFORE OVEN (i)	AFTER (f)	sample mass [illegible]
OPAL	16.87232 g	16.87117 g	.00115 g
NOPI-PI-OB14	18.052[50] g	18.0524[2] g	.00008 g
NOPI-PI-C23	18.84851 g	18.84837 g	.00014 g

OCL SUBSAMPLE GROUP A (p48) HAVE BEEN CRUSHED AND POWDERED, PLACED INTO LABELED PREWEIGHED GAMMA VIALS, AND WEIGHED.

done on 8/26 by OCL

	SAMPLE + VIAL (g)	VIAL (g)	SAMPLE (g)
A1	3.815	2.110	1.705
A2	3.929	2.116	1.813
A3	4.024	2.129	1.895
A4	3.356	2.134	1.222

8/27/93 pgh Gamma vials were prepared for the following samples:

Sample No.	Vial	Vial + Sample	wt of sample
NOP1·294 * GAM1	2.068	5.484	3.416g
NOP1·298 * GAM1	2.071	6.613	4.542g
NOP1·297 * GAM1	2.075	6.209	4.134g

8/27/93 The following samples were powdered then sieved to < 45μ. The powdered was then placed in a vial & labeled as follows.

NOP1·262 * XRD1
NOP1·261 * XRD1
NOP1·255 * XRD1

XRD Analysis has not been run on these samples.

There was an excess of NOP1-255 powder. It was placed in a vial & labeled NOP1·255 * WR1

XRD Analysis was done on NOP1·261 * XRD1

9/2/93 OCL SAMPLE SEPARATES HAVE CONTINUED SAMPLE PREPARATION FOR ALPHA SPECTROMETRY. OPAL MINERAL SEPARATE HAS CEASED IN SAMPLE PREPARATION BECAUSE THERE IS NOT ENOUGH SAMPLE TO HAVE AT LEAST 8 dpm.

mass opal : .001159 g

activity/g : 4150 dpm/g

activity : 4.81 dpm

URANOPHANE SAMPLE SEPARATES WERE SPIKED WITH A U-232/Th-228 SPIKE (25 C) ON MONDAY AUGUST 30 AND NOW ARE DRYING READY FOR U AND Th PLATING.

9/7/93 gp 1000hrs

Continuation of autoradiographic experiments.

This section, NOPI-ECP-33-TS3 which was placed on CR39 on 6/24/93 (p21) was removed from the plastic.

This sample was processed following the protedure on 024 of 077.

OCL 9-7-93 SAMPLE SEPARATES NOPI-PI-ØB14 AND NOPI-PI-C23 HAVE COMPLETED BEING PLATED AND ARE COUNTING IN THE ALPHA SPECTROMETER.

9-10-93 OCL Peggy Hunka (pgh) weighed the wet plant samples before they were dried and ashed (080|36). THE FOLLOWING DATA SHOWS THE MASS OF THE SAMPLE + BAG, MASS OF BAG, & MASS OF ALL WET (MOIST) PLANT MATTER.

MASS SAMPLE + BAGS 1495.2 g

MAS BAGS (12.6)8 = 100.8g

OCL

MASS FR-A-2 : 1.7749 g

9-10-93
OCL

Sample FR-A-2 (080/48) will be measured on the α spectrometer. The following procedure will be followed for sample preparation.

Omar C. Lagunas September 10, 1993

Plant Sample Procedure

1. Transfer sample into a 250 mL Teflon beaker and wet the sample with a few mL of Nanopure water. Add 50 mL of concentrated nitric acid and heat solution to 10 mL.

2. Centrifuge and transfer supernate into a clean Teflon beaker. Wash the residue into the original Teflon beaker.

3. Dissolve the residue in 50 mL of aqua regia solution and heat to a volume of 25 mL.

4. Centrifuge solution checking for any residue and separate supernate into clean Teflon beaker. Weigh Teflon beaker first.

5. Add 50 mL of concentrated HF to the remaining residue and 3 mL of perchloric acid. Evaporate to dryness.

6. If residue still remains, begin at step 3.

7. If this doesn't work, place residue into a steel encased Teflon bomb adding 9.5 mL of HF and placing in 110 ° C oven. Cool to room temperature before opening Teflon bomb.

8. Combine all dissolved solutions, heating solution slowly to reach equilibrium.

9. Make three sub solution samples:

- spiked which will be measured
- unspiked which will be measured
- unspiked left for further chemistry

* for all three sub samples, weigh beaker before and after adding aliquot.

Omar C. Lagunas September 10, 1993

10. Add known aliquots of ^{208}Po and ^{232}U-^{228}Th spike. Add 20 mg of Fe carrier and heat to equilibrate.

11. Add ammonium hydroxide to form precipitates. Centrifuge precipitates separating supernate. Wash precipitate twice with nanopure water.

12. Dissolve precipitate with equal volume of 2N HCl, then increase volume to 30 mL by adding 1N HCl.

13. Dump solution into clean Teflon beaker. Using a small stirring bar, heat to 80° C slowly mixing solution.

14. Add ascorbic acid until the solution turns a cloudy whitish-blue color.

15. Label a silver planchette and clean it with alconox solution.

16. Drop plate into solution with label side down. Maintain temp. at 80 degrees C covering sample with teflon watch glass.

17. Remove plate after two-three hours and count sample.

18. Prepare sample for U/Th separation by following usual procedure done on impure carbonates.

FR-A-2

~~OPAT~~ CLEAN : 105.66g

OCL 9/14 SOLN' BK. WT. :

SAMPLE FR-A-2 HAS CONTINUED FOR ALPHA SPEC. PREPARATION.

9-14 OCL PLANT SAMPLE GROUPS A (WASHED) AND B (UNWASHED) WHICH HAVE NOT BEEN PREPARED FOR γ OR α SPECTROMETRY MEASUREMENTS WILL BE STORED IN LABELED ZIPLOC BAGS.

"A" LABELED BAGS - WERE WASHED (080/36) & (3) DRIED IN THE OVEN.

"B" LABELED BAGS - WERE DRIED IN OVEN. (089/35) (2)

THE FIVE ZIPLOC BAGS ARE STORED IN THE GLASSWARE CABINET ACROSS FROM THE PERCHLORIC FUME HOOD.

OCL FR-A-2 SOLN + BK. WT. : 201.62
BEAKER WT. 105.66
95.97

↓ split into 3 SUBSAMPLES

FR-A-2 : SUBSAMPLE 3 (for chem.) SOLN + BK WT. 73.62 g
BK WT. 25.68 g
47.94 g

SUBSAMPLE 2 (unspiked) SOLN + BK WT 133.91
BK WT. 107.80
26.11 g

SUBSAMPLE 3
(spiked)

soln + bk. wt. 129.52
bk. wt. 105.66g
23.86 g

9/24/93 JP The Th and U opal samples left by Omar Lugano were plated and placed on the alpha-spectrometer for county.

9/27/93 JP The plant samples FR-A-2 (spiked) and FR-A-2 (unspiked) left by Omar Lugano were separated for U and Th following procedure on p 43.

9/29/93 JP Plated FR-A-2 (spiked) and FR-A-2 (unspiked). U + Th. and placed on alpha-spectrometer for county.

10/5/93 Prepare Whole Rock Powders

These samples were taken from a vertical fracture on the +10 level.

NOPI-173*WRI (NOPI-ECP-10-25/2A) is a subsample of NOPI-173. Dark red clay like material, plastic, iron-rich. Thin white vein material throughout.

NOPI-174*WRI (NOPI-ECP-10-25/2B) is a subsample of NOPI-174. Black to dark red clay like material.

NOPI-175*WRI (NOPI-ECP-10-25/2C) is a subsample of NOPI-175. Altered Nopal tuff directly adjacent to fracture containing clay like gouge material.

The above samples were powdered in a tungsten carbide vial using a SPEX 8000 Mixer Mill

After powding the samples were weighed and placed in labeled plastic sample containers.

Weight of powders are listed below:

NOPI-~~174~~ 173 *WRI	10.5 g
NOPI-174*WRI	10.17 g
NOPI-175*WRI	14.1 g

10/6/93 JF Samples for gamma county were prepared as follows:

Sample	Wt pp Vial	Wt vial + sample	Wt sample
NOPI-173*GAMI	2.076 g	6.160 g	4.084 g
NOPI-174*GAMI	2.058 g	6.914 g	4.856 g
NOPI-175*GAMI	2.068 g	5.592 g	3.524 g

10/8/93 gp Prepared samples for thin sections Santorini samples.

Portions of the following bulk rock samples from Santorini Greece were selected and placed in labeled plastic bags. Labeled as follows:

SAN-022-TS1
SAN-026-TS1
SAN-030-TS1
SAN-038-TS1
SAN-041-TS1
SAN-046-TS1
SAN-050-TS1
SAN-053-TS1
SAN-020-TS1

These rocks samples will be sent to Mineral Optics lab for impregnation and thin section production.

10/8/93 gp The following samples from Santorini Greece were prepared for qualitative XRD analysis. Bulk XRD

SAN-053-XRD1 - bulk
SAN-050-XRD1 - bulk
SAN-022-XRD1 - fine unconsolidated material
SAN-022-XRD2 - consolidated chunks of tuff

10/11/93 gp
SAN-026-XRD1 - bulk
SAN-030-XRD1 - bulk
SAN-038-XRD1 - bulk
SAN-020-XRD1 - bulk
SAN-041-XRD1 - bulk
SAN-046-XRD1 - bulk

10/11/93 JP Recieved thin sections from Mineral Optics lab. Most of these sections are from the +0 level at ~~Pena~~ Nopal I. The order form is shown below

Mineral Optics Laboratory

P.O. Box 828
Wilder, Vermont 05088

29 "A" Street
(802) 295-9373

PETROGRAPHY ORDER CHECKLIST

Bill To: James D Pitkyl
Address: SWRI / Div 20 / Bldg 57
6220 Culebra Rd
City, State, ZIP San Antonio TX 78228

Ship To: Same
Address:
City, State, ZIP

Date 1/17/93 | Order No. | Customer P.O. | Received | Shipped | Phone 210-522-5667 | Shipped via

Sample No.	Size: Quantity	Size: 27 x 46 mm	Size: 1.5 x 3 in.	Size: 2 x 3 in.	Size: 1" or 1.25 dia.	Size: Other	Size: Thick mm	Size: Thin mm	Finish: Standard .03 mm	Finish: Std Lapped	Finish: 1 Side Polish	Finish: 2 Side Polish	Impreg.: Clear Resin	Impreg.: Color Resin	Stain: Grains, Cutting	Stain: Carbonate	Stain: Feldspar	Cut: Bulk Sample	Cut: Oriented	Other: Other Cement	Other: Water Soluble	Other: W/Cover Glass	Other: No Cover Glass	Other: Discard Mat'l
* NOTE - All samples contain uranium minerals and are radioactive. Take precautions when handling and during preparation.																								
LOTS-1	2	✓						✓	✓									✓						
LOTS-2																								
LOTS-3	1	✓						✓	✓									✓						
LOTS-4	1	✓						✓	✓									✓						
LOTS-5	1	✓						✓	✓									✓						
LOTS-6	1	✓						✓	✓									✓						
LOTS-7	1	✓						✓	✓									✓						
LOTS-8	1	✓						✓	✓									✓						
LOTS-9	1	✓						✓	✓									✓						
LOTS-10	1	✓						✓	✓									✓						
LOTS-11	1	✓						✓	✓									✓						
LOTS-12	1	✓						✓	✓									✓						
LOTS-13	1	✓						✓	✓									✓						
LOTS-14	1	✓						✓	✓									✓						
LOTS-15	1	✓						✓	✓									✓						
LOTS-16	1	✓						✓	✓									✓						
LOTS-17	1	✓						✓	✓									✓						
LOTS-18	1	✓						✓	✓									✓						
LOTS-19	1	✓						✓	✓									✓						
LOTS-20	1	✓						✓	✓									✓						
LOTS-21	1	✓						✓	✓									✓						
LOTS-22	1	✓						✓	✓									✓						
LOTS-23	1	✓						✓	✓									✓						
LOTS-24	1	✓						✓	✓									✓						
* Please return remainder of all samples after cutting.																								

Polished thin sections.
These samples consist of bulk pieces that need to be cut. Please cut out thin section blocks along the black lines that are drawn on the samples.

Mineral Optics Laboratory

P.O. Box 828
Wilder, Vermont 05088

29 "A" Street
(802) 295-9373

PETROGRAPHY ORDER CHECKLIST

Bill To: James D Pitkyl
Address:
City, State, ZIP

Ship To: Same
Address:
City, State, ZIP

Date | Order No. | Customer P.O. | Received | Shipped | Phone | Shipped via

Sample No.	Size: Quantity	Size: 27 x 46 mm	Size: 1.5 x 3 in.	Size: 2 x 3 in.	Size: 1" or 1.25 dia.	Size: Other	Size: Thick mm	Size: Thin mm	Finish: Standard .03 mm	Finish: Std Lapped	Finish: 1 Side Polish	Finish: 2 Side Polish	Impreg.: Clear Resin	Impreg.: Color Resin	Stain: Grains, Cutting	Stain: Carbonate	Stain: Feldspar	Cut: Bulk Sample	Cut: Oriented	Other: Other Cement	Other: Water Soluble	Other: W/Cover Glass	Other: No Cover Glass	Other: Discard Mat'l
* NOTE - Please vacuum impregnate the 7 samples below with dilute epoxy																								
LOTS-37	1	✓									✓	✓		✓										
LOTS-50	1	✓									✓	✓		✓										
22.5/10.4-TS4	1	✓									✓	✓		✓										
22.35/15.3-TS3	1	✓									✓	✓		✓										
N-PI-ECP-33-TS4	1	✓									✓	✓		✓										
LOTS-51	1	✓									✓	✓		✓										
LOTS-52	1	✓									✓	✓		✓										
* Return remainder of all samples.																								

Polished thin sections
This group of samples have already been cut - use faces without "X" marks.

These two samples need to be cut after impregnation. Please cut along the black line indicated on the sample.

Thin sections were relabeled to reflect New numbering system. See following page.

New thin section numbers. Number were placed on thin section with diamond tipped pen.

OLD	NEW
LOTS-1	NOPI-271-TS1
LOTS-2	NOPI-271-TS2
LOTS-3	NOPI-271-TS3
LOTS-4	NOPI-271-TS4
LOTS-5	NOPI-271-TS5
LOTS-6	NOPI-271-TS6
LOTS-7	NOPI-271-TS7
LOTS-8	NOPI-293-TS1
LOTS-9	NOPI-286-TS1
LOTS-10	NOPI-283-TS1
LOTS-11	NOPI-282-TS1
LOTS-12	NOPI-280-TS1
LOTS-13	NOPI-256-TS1
LOTS-14	NOPI-269-TS1
LOTS-15	NOPI-285-TS1
LOTS-16	NOPI-285-TS2
LOTS-17	NOPI-291-TS1
LOTS-18	NOPI-292-TS1
LOTS-19	NOPI-254-TS1
LOTS-20	NOPI-287-TS1
LOTS-21	NOPI-273-TS1
LOTS-22	NOPI-272-TS1
LOTS-23	NOPI-270-TS1
LOTS-24	NOPI-260-TS1
LOTS-37	NOPI-268-TS1
LOTS-50	NOPI-268-TS2
LOTS-51	NOPI-294-TS1
LOTS-52	NOPI-301-TS1

10/14/93 JP

Following are the weights of spike #25C (U-232/Th-228) added to mineralbone samples NOPI-PI-OB14 and NOPI-PI-C23 and the opal sample that were previously prepared for α-spectrometry analysis (p 47).

NOPI-PI-OB14 - .2470g
NOPI-PI-C23 - .2295 g
OPAL - .1137g

These weights are recorded in the "Radionuclide Inventory and Daily Inventory Usage Log"

10/18/93 ECP

These are samples sent to Div. 01 → Mike DAMMANN for trial Analysis of Cu-alloys. If their Analyses are found to be adequate, we will use them for the bronze samples from Akrotiri collected during the summer 1993 trip.
THESE samples ARE NBS STANDARD ALLOYS AND A series of Oxides cut from available copper sheet.
Sizes (weights) will approximate those available from the actual bronzes from Akrotiri.

MO1 - 9×10^{-4} g sheet Cu
MO2 - 1.85×10^{-3} g NBS 396
MO3 - No. Not used
MO4 - 1.6×10^{-3} g sheet Cu

MD5 6.9×10^{-3} g NBS 871 (COA 521)
MD6 No. Not used
MD7 5.0×10^{-3} g NBS 396
MD8 8.9×10^{-3} g NBS 871 (COA 521)
MD9 No. Not used
MD10 ~~1.7~~ ECP 10/18/93 Sheet Cu
1.7×10^{-3} g

MD11 9.7×10^{-3} g NBS 396
MD12 ECP 10/18/93
~~ECP 10/18/93 MD13 6.8 6.3×10^{-3} g NBS 871 (COA 521)~~
MD14 No. Not used.
MD15 3.17×10^{-3} g NBS 396
MD16 5.1×10^{-3} g NBS 871 (COA 521)

Results on PAGE 91
ECP 1/25/94

10/18/93 Prepared corrosion fragments collected from Santorini, Greece for SEM/EDS analysis.

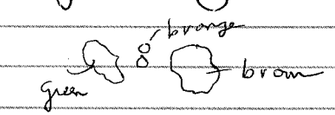
A small subsample of copper corrosion products from the following samples were placed on aluminum stubs and coated with carbon.

	Stub No
SAN-010-SEP1	1
SAN-018-SEP1	2
SAN-055-SEP1	3
SAN-056-SEP1	4

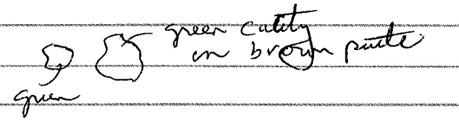
Photographed samples (slides) after mount on alumin stubs but before coating. Used Nikon binocular microscope in petrography lab. Slides are kept in a three ring binder entitled "Santorini, Greece Sample Photographs"

Descriptions from microscopic observation

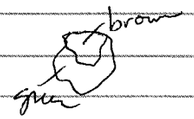
SAN-056 - Green Cu particle adjacent to brown particle with some green ring. In between here small brange looking particles.



SAN-055 Green particle adjacent to larger particle consisty of green corty on brown-red core.



SAN-018 Brown red particle surrondy by green corrosin product.



SAN-011 Green particle with small brown particles nearby.

Brown.

11/4/93 JP

Sample SAN-056 consisting of corrosion material from an artifact from Santorini, Greece was analyzed by XRD.

SAN-056*XRD1 is a subsample of SAN-056 and consist of fine powder (dark green in color) and a small piece of dark green corrosion particle.

SAN-056*XRD2 is a subsample of SAN-056 and consist of a light green material chipped off a large light green particle.

12/2/93 JP Recieved thin sections from Mineral Optics Laboratory. Samples from to level at Nopal I and Santorini Greece. Order form with sample numbers are shown below.

Mineral Optics Laboratory

P.O. Box 828 'Wilder. Vermont 05088 — 29 "A" Street (802) 295-9373

PETROGRAPHY ORDER CHECKLIST

Bill To: James D. Farley
Address: HQRI / DIV 20 : Bldg 57
220 Culebra Rd
City, State. ZIP San Antonio TX 78228

Ship To: Same
Address:
City, State. ZIP

Date 10/12/93 — Order No. — Customer P.O. — Received — Shipped — Phone 210-522-5667 — Shipped via

Sample No.	Size: Quantity	Size: 27 x 46 mm	Size: 1.5 x 3 in	Size: 2 x 3 in	Size: 1" or 1.25 dia	Size: Other	Size: Thick mm	Size: Thin mm	Size: Standard 03 mm	Finish: Std Lapped	Finish: 1 Side Polish	Finish: 2 Side Polish	Impreg.: Clear Resin	Impreg.: Color Resin	Impreg.: Grains, Cutting	Stain: Carbonate	Stain: Feldspar	Cut: Bulk Sample	Cut: Oriented	Other: Other Cement	Other: Water Soluble	Other: W/Cover Glass	Other: No Cover Glass	Discard Mat'l
NOPI-278-TS1	1		✓						✓		✓													
NOPI-277-TS1	1		✓						✓		✓													
NOPI-257-TS1	1		✓						✓		✓													
NOPI-240-TS1	1		✓						✓		✓													
NOPI-279-TS2	1		✓						✓		✓													
NOPI-259-TS1	1		✓						✓		✓													
NOPI-264-TS1	1		✓						✓		✓													
NOPI-239-TS1	1		✓						✓		✓													
NOPI-267-TS1	1		✓						✓		✓													
NOPI-279-TS1	1		✓						✓		✓													
NOPI-263-TS1	1		✓						✓		✓													
NOPI-266-TS1	1		✓						✓		✓													
NOPI-276-TS1	1		✓						✓		✓													
NOPI-253-TS1	1		✓						✓		✓													
NOPI-255-TS2	1		✓						✓		✓													
NOPI-238-TS1	1		✓						✓		✓													
NOPI-262-TS1	1		✓						✓		✓													
NOPI-275-TS1	1		✓						✓		✓													
NOPI-256-TS1	1		✓						✓		✓													
NOPI-288-TS2	1		✓						✓		✓													
NOPI-274-TS1	1		✓						✓		✓													
NOPI-274-TS2	1		✓						✓		✓													
NOPI-261-TS1	1		✓						✓		✓													

Polished thin sections. These samples have been cut - use faces without "x" marks.

* Return remainder of all samples

Mineral Optics Laboratory

P.O. Box 828 'Wilder. Vermont 05088 — 29 "A" Street (802) 295-9373

PETROGRAPHY ORDER CHECKLIST

Bill To: James D. Farley
Address:
City, State. ZIP

Ship To:
Address:
City, State. ZIP

Date — Order No. — Customer P.O. — Received — Shipped — Phone — Shipped via

Sample No.	Size: Quantity	Size: 27 x 46 mm	Size: 1.5 x 3 in	Size: 2 x 3 in	Size: 1" or 1.25 dia	Size: Other	Size: Thick mm	Size: Thin mm	Size: Standard 03 mm	Finish: Std Lapped	Finish: 1 Side Polish	Finish: 2 Side Polish	Impreg.: Clear Resin	Impreg.: Color Resin	Impreg.: Grains, Cutting	Stain: Carbonate	Stain: Feldspar	Cut: Bulk Sample	Cut: Oriented	Other: Other Cement	Other: Water Soluble	Other: W/Cover Glass	Other: No Cover Glass	Discard Mat'l
* Please vacuum impregnate the 9 samples below with blue-dyed epoxy before cutting.																								
SAN-022-TS1	1		✓						✓			✓		✓					✓					
SAN-026-TS1	1		✓						✓			✓		✓					✓					
SAN-030-TS1	1		✓						✓			✓		✓					✓					
SAN-033-TS1	1		✓						✓			✓		✓					✓					
SAN-041-TS1	1		✓						✓			✓		✓					✓					
SAN-046-TS1	1		✓						✓			✓		✓					✓					
SAN-050-TS1	1		✓						✓			✓		✓					✓					
SAN-053-TS1	1		✓						✓			✓		✓					✓					
SAN-C26-TS1	1		✓						✓			✓		✓					✓					

Polished thin sections. Cut out thin section blocks after impregnation.

* Return remainder of all samples.

* Note - The following 3 samples are radioactive - take precautions when preparing.

NOPI-271-TS4	1		✓						✓			✓		✓					✓					
NOPI-271-TS9	1		✓						✓			✓		✓					✓					
NOPI-271-TS10	1		✓						✓			✓		✓					✓					

Polished thin sections - cut along black line on left as necessary to reduce size.

* For the above 3 samples we are most interested in black part of rock.

1/5/94 JP Preparation of Whole Rock Powders (0 Level Samples - Nopal I).

The following samples are from an east-west traverse on the cleaned 0 level surface between 2 and 3 m east. Powders will be used for gamma spectrometry, XRD, and major & trace element analysis.

NOPI-254*WRI is a subsample of NOPI-254. Very broken, altered, hematitic, limonitic, kaolinitized. Contains uranyl silicates along fracture surfaces.

1/6/94 JP NOPI-255*WRI is a subsample of NOPI-255. Reddish-brown (slightly hematitic tuff. Kaolinized - in fractures & replacing feldspar phenocrysts. Some fractures contain or are lined with uranyl silicates and iron oxides.

NOPI-256-WRI is a powdered subsample of NOPI-256. Reddish-brown (hematitic) altered tuff with uranyl silicates in fractures. Kaolinized - in fractures and replacing feldspar phenocrysts + feldspar in matrix.

NOPI-257-WRI is a subsample (powdered) of NOPI-257. Altered tuff, very kaolinitized, strongly limonitic, slightly hematitized. Uranyl silicates and kaolinite in fractures and coating surfaces of fractures. Feldspar replaced by kaolinite. Some iron oxides on fracture surfaces.

NOPI-258-WRI is a powdered subsample of NOPI-258. Altered tuff, strongly kaolinitized, very limonitic, slightly hematitic. Some iron-oxides coating fractures. Uranyl silicates + kaolinite in fractures. Feldspar replaced by kaolinite.

NOPI-259-WRI is a powdered subsample of NOPI-259. Kaolinitized / limonitic tuff. Fractures contain kaolinite, some iron oxide, + minor uranyl silicates. Feldspar replaced by kaolinite. This sample does not seem as altered as previous samples + appears to contain less uranyl silicates in fractures.

NOPI-260-WRI is a powdered subsample of NOPI-260. Very broken, altered tuff, very kaolinized, limonitic, with dark red iron oxides coating some fractures. Uranyl silicates and kaolinite in fractures.

1/7/94 gf

NOPI-261-WRI is a powdered subsample of NOPI-261 Altered tuff, tuff matrix appears hematite (red in color). Kaolinized with kaolinite replacing feldspar and in fractures. Some fractures coated with dark red iron oxides (hematite). No visible mafic silicates. Some limonite. Upon breaking matrix does not appear highly hematitic (brownish in color).

NOPI-262-WRI is a powdered subsample of NOPI-262. Limonite/hematite tuff. Kaolinized with kaolinite replacing feldspars & in fractures. Fracture surfaces are often coated by dark red iron oxides (hematite) and lesser goethite (yellow limonite). No visible mafic silicates.

NOPI-263-WRI is a powdered subsample of NOPI-263. Very kaolinized/altered tuff. Kaolinite replaced feldspars. Limonite (yellow orange color). Red colored material (hematite) coats some fracture surfaces. No visible mafic silicates.

NOPI-264-WRI is a powdered subsample of NOPI-264. Hematitic altered tuff. Red-colored matrix indicates rock has been strongly hematized. Black & dark red material (hematite, fe oxide) coats fractures. Kaolinite - phenocrysts of ~~plag~~ feldspars in matrix have been replaced by kaolinite. Kaolinite also occurs in fracture. No visible mafic silicates.

1/10/94 gf

NOPI-265-WRI is a powdered subsample of NOPI-265. Hematized, broken tuff. Dark red matrix indicates strong hematization. Kaolinite replaced feldspars & in fractures. Fractures filled by iron oxides - black, red. A yellow-green mineral occurs in fractures & as a coating - this mineral may be jarosite.

NOPI-266-WRI is a powdered subsample of NOPI-266. Hematitic, fractured tuff. Dark red matrix suggests strong hematization. Kaolinite replaces feldspars & occurs in fractures. Fractures filled or coated by iron oxides - black, dark red. A yellow-green mineral occurs in fractures and may be jarosite.

NOPI-267-WRI is a powdered subsample of NOPI-267. Very hematitic, fractured tuff. Matrix of tuff very hematitic. Kaolinite replaces feldspar & occurs in fractures. Fractures are filled or coated by iron oxides.

NOPI-268-WRI is a powdered subsample of NOPI-268. Very hematitic, broken tuff. Matrix hematitic as evidenced by red color. Kaolinite replaces feldspar & occurs in fractures. Fractures coated and filled by iron oxides. Jarosite may also occur in fractures as a yellow green material.

1/6/94 JP Analysis of Fe-oxide bearing fractures from the Nopal I deposit were initiated. The purpose of these analyses are to determine how transported uranium is sited within or on what minerals; precipitation vs. sorption; which minerals are most important.
Analyses will consist of petrographic descriptions; x-ray diffraction; SEM/EDS and whatever other techniques are required.
Descriptions, photos, & data will be kept in a 3 ring binder entitled "Analyses of Fe-oxide bearing fractures at Nopal I, Chihuahua, Mexico".

1/6/94 JP NOPI-268 Altered tuff with abundant iron oxides that fill fractures. Fe-oxides in fracture (black to dark red metallic material) was separated by picking for x-ray diffraction analysis. The material was powdered; ~~Al powder was added as an internal reference~~, and powdered was placed in a plastic vial labeled NOPI-268-~~XRD~~FMI JP 1/4/94 Fale To ~~Dick Oc~~ for analysis. ~~Al powder was added to an aliquot as an internal reference.~~ JP 1/6/94

NOPI-268-FMI is a subsample of NOPI-268. Fe-oxide fracture fill material. Black to dark red in color.

1/7/94 JF

NOPI-268-FM2 is a subsample of NOPI-268 Fracture fill material (Fe-oxide). Red, black & yellow in color. Yellow mated may be jarosite or prone to altered tuff contained within fracture (breccia material).

Portions of whole rock and fracture material powders were taken and prepared for XRD analysis in Div 06. Samples were labeled as follows.

NOPI-254-XRD1 - portion of NOPI-254-WR1

NOPI-268-XRD2 - portion of NOPI-268-FR1 (Al powder added as internal reference).

1/11/94 NOPI-268-XRD3 - portion of NOPI-268-FM2 (Al powder added as internal reference).

NOPI-255-XRD1 - portion of NOPI-255-WR1

NOPI-256-XRD1 - portion of NOPI-256-WR1

NOPI-257-XRD1 - portion of NOPI-257-WR1

NOPI-258-XRD1 - portion of NOPI-258-WR1

NOPI-259-XRD1 - portion of NOPI-259-WR1

1/19/94 NOPI-260-XRD1 - portion of NOPI-260-WR1

NOPI-261-XRD1 - portion of NOPI-261 ~~XRD1~~ WR1 JF 1/19/94

NOPI-262-XRD1 - portion of NOPI-262 ~~XRD~~ WR1 JF 1/19/94

1/24/94 NOPI-263-XRD1 - portion of NOPI-263-WR1

NOPI-264-XRD1 - portion of NOPI-264-WR1

NOPI-265-XRD1 - portion of NOPI-265-WR1

NOPI-266-XRD1 - portion of NOPI-266-WR1

NOPI-267-XRD1 - portion of NOPI-267-WR1

NOPI-268-XRD1 - portion of NOPI-268-XRD1

1/11/94 JF Preparation of whole rock powders (0 Level, Nopal I)

The following samples are from a NW-SE transect on 0 level across an area of slickensided sides which may be a boundary fault for the deposit.

NOPI-269-WR1 is a powdered subsample of NOPI-269. Broken altered tuff. Red-brown matrix suggest moderate hematization. Kaolinite replaced feldspar + occurs in fractures. Fractures also contain limonite-hematite and mangl silicates. Oxidized pyrite can be observed in fractures.

NOPI-270-WR1 is a powdered subsample of NOPI-270. Brown-red hematitic matrix. Kaolinite replaces feldspars and occurs in fractures. Fracture contain dark red hematite either filling or coating fracture. Mangl silicates are visible in fractures with oxidized pyrites.

NOPI-271-WR1 is a powdered subsample of NOPI-271. Silicified broken altered tuff. Contains black pods of pyrolusite as a fracture fill. Matrix is red-brown indicating moderate hematization. Kaolinite replaced feldspars & occurs in fractures. Limonite in fractures has been oxidized to mangl minerals. Oxidized pyrite are visible in fractures.

1/12/94 JF NOPI-272-WR1 is a powdered subsample of NOPI-272. Hematized/kaolinite tuff that is very broken up. Kaolinite replaces feldspars & occurs in fractures. Brownish matrix indicates hematization. Fractures contain Fe-oxides & mangl silicate minerals.

NOPI-273-WR1 is a powdered subsample of NOPI-273. Hematitic, broken, altered tuff. Brown-red color indicates hematization. Kaolinite replaces feldspars & occurs in fractures. Fractures contain Fe-oxide of varying color and mangl silicates.

NOPI-274-WR1 is a subsample (powdered) of NOPI-274. Limonite / hematite altered tuff. Matrix is limonite and is hematitic. Veins fractures which contain hematite. Kaolinite replaces feldspar & occurs in fractures. Fractures contain Fe oxides - black and red, hematite and more yellow limonite. No visible ironmineralds.

NOPI-275-WR1 is a powdered subsample of NOPI-275. Altered tuff. Red-brown matrix indicates hematite. Kaolinite replaces feldspar and occurs in fractures. Fractures are coated or filled by Fe-oxides. No visible iron minerals.

1/17/94 JP Samples for gamma counting; all are subsamples of whole rock (WR1) powders.

Sample	Wt. of vial	Wt. Vial + sample	Wt. sample
NOPI-254-GAM1	2.064 g	5.976 g	3.912 g
NOPI-255-GAM1	2.070 g	5.894 g	3.824 g
NOPI-256-GAM1	2.058 g	5.848 g	3.790 g
NOPI-257-GAM1	2.056 g	5.628 g	3.572 g
NOPI-258-GAM1	2.079 g	5.615 g	3.536 g
NOPI-259-GAM1	2.054 g	5.598 g	3.544 g
NOPI-260-GAM1	2.069 g	5.676 g	3.607 g
NOPI-261-GAM1	2.076 g	5.837 g	3.761 g
WOPI-262-GAM1	2.053 g	5.487 g	3.434 g
NOPI-263-GAM1	2.062 g	5.493 g	3.431 g
NOPI-264-GAM1	2.071 g	5.769 g	3.698 g
NOPI-265-GAM1	2.074 g	5.581 g	3.507 g
NOPI-266-GAM1	2.064 g	5.683 g	3.619 g
NOPI-267-GAM1	2.072 g	6.396 g	4.324 g
NOPI-268-GAM1	2.058 g	6.460 g	4.402 g

1/14/94 gfp NOPI-294-XRD2 - Fracture filling iron oxides separated from bulk rock by hand picking NOPI-294 Sample was powdered, Al powder was added as intern. ref. for XRD analysis.

NOPI-301-XRD2 - Fracture filling iron oxides separated from bulk rock sample NOPI-301 Sample was powdered; Al powder was added as intern ref. for XRD analysis.

gfp 1/19/94 gfp 1/19/94

1/19/94 NOPI-~~301~~ 296 -XRD1 - Portion of NOPI-~~294~~ 296 -WR1. Red fracture fill, Fe-oxide material.

NOPI-298-XRD1 - Portion of NOPI-298-WR1 Fe-oxide fracture fill

NOPI-299-XRD1 - Portion of NOPI-299-GAM1 Fe-oxide fracture fill.

1/24/94 Autoradiography of iron oxide bearing fractures.

Autoradiographic analysis performed to determine sites of uranium concentration in iron oxide bearing fractures.

The following thin sections were placed face down on CR-35 plastic and allowed to sit.

	label on plastic
NOPI-294-TS1	294
NOPI-301-TS1	301
NOPI-268-TS1	268

1/24/94 Auger study -

Mineral separates of Fe-oxides and jarosite where prepared for auger analysis. The following minerals were separated from the bulk sample and labeled as follows:

NOPI-294-SEP1 - Black Fe-oxide growing in a fracture from hematized tuff substrate Botryoidal texture. Some jarosite grows onto from the black Fe-oxide.

NOPI-294-SEP2 - Black Fe-oxide lines open space from hematized substrate. Botryoidal texture. Euhedral jarosite grows from the black Fe-oxide mineral.

NOPI-294-SEP3 - Black Fe-oxide grows from hematized tuffaceous substrate. Fe-oxide often covered by euhedral jarosite.

NOPI-301-SEP1 - Fe-oxide grows into open space from tuffaceous substrate Fe-oxide has somewhat botryoidal texture and is very porous.

NOPI-301-SEP2 - Orange colored mineral (jarosite or goethite) grows into an open space from a tuffaceous substrate. Intergrown with Fe-oxide (black mineral) in some areas.

NOPI-301-SEP3 - Black to dark red Fe-oxide growing into open space. Flaky texture but surface somewhat botryoidal. Orange material on surface in some areas.

NOPI-301-SEP4 - black Fe-oxide material growing into open void. Flaky, porous texture.

1/25/94

The following mineral seperates were mounted on a Auger sample holder with carbon paint.

NOPI-294-SEP2
NOPI-301-SEP1
NOPI-301-SEP2
NOPI-301-SEP3

The samples were taken to Jim Spencer in Div 06 for Auger analysis.

2/18/94 JP
Results of Auger analysis are kept in the 3 ring binder entitled "Analyses of Fe-oxide bearing fractures at Nopal I, Chihuahua, Mexico."

ICP 1/25/91

Results of trial analyses of Cu in preparation for bronze corrosion product analyses. Analytical work by Mike Dammann, Surface Division 01 by ICP.

SAMPLE ID	MD1	MD2	MD4	MD5	MD7	MD8	MD10	MD11	MD15	MD16
Initial Wt(g)	0.00097	0.00172	0.00196	0.00599	0.00497	0.0074	0.00178	0.00971	0.00317	0.00432
MDL(ug/ml)										
Ag	0.01 <206	<116	<102	<33	<40	<27	<112	<21	<63	<46
Al	0.05 <1031	<581	<510	175	<201	165	932	<103	<315	<231
As	0.05 <1031	<581	<510	<167	<201	<135	<559	<103	<315	<231
Ba	0.01 <206	<116	<102	<33	<40	<27	<112	<21	<63	<46
Be	0.01 <206	<116	<102	<33	<40	<27	<112	<21	<63	<46
Bi	0.05 1047	1349	1185	901	1258	970	1393	1223	1235	950
Cd	0.01 <206	<116	<102	<33	<40	<27	<112	<21	<63	<46
Co	0.01 <206	<116	<102	<33	<40	<27	<112	<21	<63	<46
Cr	0.01 1020419	1047784	995045	658138	976548	*****	1004637	*****	975137	753680
Cu	0.05 <1031	<581	<510	<167	<201	<135	685	165	<315	<231
Fe	0.01 <206	<116	<102	<33	<40	<27	<112	<21	<63	<46
Li	0.01 <206	<116	<102	<33	<40	<27	<112	28	<63	<46
Mn	0.01 <206	<116	<102	<33	<40	<27	<112	<21	<63	<46
Mo	0.01 <206	<116	<102	181	<40	<27	<112	<21	<63	<46
Ni	0.01 <206	<116	<102		<40	<27	<112	<21	<63	<46
Pb	0.05 <1031	<581	<510	<167	<201	<135	<559	<103	<315	<231
Sb	0.05 <1031	<581	<510	<167	<201	<135	<559	<103	<315	<231
Se	0.05 <1031	<581	<510	<167	<201	<135	<559	<103	<315	<231
Sn	0.05 <1031	<581	<510	60078	<201	75279	<559	<103	<315	70131
Tl	0.01 <206	<116	<102	<33	<40	<27	<112	<21	<63	<46
Th	0.05 <1031	<581	<510	<167	<201	<135	<559	<103	<315	<231
V	0.01 <206	<116	<102	<33	<40	<27	<112	<21	<63	<46
Zn	0.01 3082	2873	3003	2386	2723	2404	3106	2730	2738	2287
SUM	1024548	1052006	999232.7	721858.4	980528.6	78816.49	1010753	4142.739	979109.8	827026.9
%	102.45%	105.20%	99.92%	72.19%	98.05%	7.88%	101.08%	0.41%	97.91%	82.70%

Final volume was 20ml.
Sample concentrations are in ug/g.

***** Cu was over-range. Due to limited sample volume, a dilution was not possible.

These analyses are determined to be unacceptable. High precision (for such small samples) V.V. low accuracy. It appears that there is some systematic error rendering the analyses un-usable. We will not be able to use this technique for analysis of the bronze corrosion products. For such small samples, microbeam analysis may be the best answer.

1/26/94 Continued preparation of whole rock powder (level 0), Nopal I)

NOPI-276-WR1 is a powdered subsample of NOPI-276. Altered hematite/Imonite tuff. Kaolinite visible replacing feldspar matrix + occurs in fractures. Fractures coated by red to red-orange Fe-oxide. No visible U minerals. Black material (Mn-oxide?) occurs on surfaces.

NOPI-277-WR1 is a powdered portion of NOPI-277. Altered, fractured hematite/Imonite tuff. Kaolinite replaces feldspar + occurs in fractures. Red to red-orange Fe-oxides coat fractures. No visible U minerals.

NOPI-278-WR1 is a powdered subsample of NOPI-278 Altered Imonite tuff. Kaolinite replaces feldspars. Red Fe oxide coats some fractures along with patchy black material (Mn-oxide?).

1/27/94 NOPI-279-WR1 is a powdered subsample of NOPI-279. Altered, limonite tuff. Kaolinite replaces feldspar & matrix. No visible Ti-minerals. Black material (Fe, Mn oxides) coats some surfaces.

Random 0 ~~feet~~ level samples:

NOPI-280-WR1 is a powdered subsample of NOPI-280. Very hematized tuff (bad). Fractures are coated by black Fe-oxide which is in turn covered by yellow mesophane and possibly opal.

NOPI-281-WR1 is a powdered subsample of NOPI-281. Very hematized tuff. Fracture surfaces coated with black Fe-oxide covered by yellow mesophane and possibly opal.

NOPI-282-WR1 is a powdered subsample of NOPI-282. Very hematized tuff. Fracture surfaces filled + coated with black Fe-oxide. Fe-oxides are in turn covered by yellow mesophane + possibly opal.

1/27/94 Portions of whole rock powders were prepared for XRD analysis in Div 06. Samples labelled as follows:

NOPI-269-XRD1 – portion of NOPI-269-WR1

NOPI-270-XRD1 – portion of NOPI-270-WR1

NOPI-271-XRD1 – portion of NOPI-271-WR1

NOPI-272-XRD1 – portion of NOPI-272-WR1

NOPI-273-XRD1 – portion of NOPI-273-WR1

NOPI-274-XRD1 – portion of NOPI-274-WR1

NOPI-275-XRD1 – portion of NOPI-275-WR1

NOPI-276-XRD1 – portion of NOPI-276-WR1

1/27/94 JF

Preparation of whole rock powders (level 0) continued:

NOPI-283-WR1 is a powdered subsample of NOPI-283. Strongly hematized tuff. Black Fe-oxides coat surfaces and fractures. Yellow mineraloid and opal overgrow the Fe oxide coats.

NOPI-284-WR1 is a powdered subsample of NOPI-284. Strongly hematized tuff. Black Fe-oxide coat surfaces + fractures. Yellow mineraloid and opal overgrow black Fe-oxide coatings.

1/28/94 JF

NOPI-285-WR1 is a powdered subsample of NOPI-285. Altered, broken hematitic tuff. Kaolinite replaced feldspar + occurs in fractures. Hematite also coats some fractures. Mangl silicates (yellow minerals) occur in fractures. Rock is also silicified.

NOPI-286-WR1 is a powdered subsample of NOPI-286. Altered, broken, hematized tuff. Kaolinite replaced feldspar + fill fractures. Fe oxides coat fractures + replaced pyrites are visible. Mangl silicates occur in fractures also.

NOPI-287-WR1 is a powdered subsample of NOPI-287. Hematized, Fe-oxide rich altered tuff. Kaolinite replaces feldspar + occurs in fractures. Fe-oxides coat surfaces + occur in fractures. No visible manganese minerals.

1/31/94 JF

NOPI-288-WR1 is a powdered subsample of NOPI-288. Very hematized broken tuff. Kaolinite replaced feldspar + occurs in fractures. Fractures contain Fe oxide as coatings and fill. (hematite and goethite) No visible Mn minerals. Fractures contain black lustrous mineral (possibly Mn-oxide).

NOPI-289-WR1 is a powdered subsample of NOPI-289. Kaolitized, hematite tuff. Kaolinite replaces feldspars. Fractures often contain a dark red hematitic coating on surfaces. No visible manganese minerals.

NOPI-290-WR1 is a powdered subsample of NOPI-290 Kaolitized, hematite tuff. Kaolinite replaces feldspars. Some dark red material (hematite) coats fractures. No visible Mn minerals.

NOPI-291-WRI is a powdered subsample of NOPI-291. Altered, broken mineralized Tuff. Yellow green minerals visible in fractures + interspersed with kaolinite in fracture. Kaolinite replaces feldspar in matrix. Dark (black-red) Fe oxides are present as coatings in fracture.

NOPI-292-WRI is a powdered subsample of NOPI-292. Altered kaolinized Fe-oxide rich tuff. Feldspars replaced by kaolinite. Matrix appears hematitic/limonitic. Fracture surfaces coated by kaolinite and yellow green minerals

2/1/94 gp NOPI-293-WRI is a powdered subsample of NOPI-293. Mineralized, broken Tuff. Kaolinite replaces feldspar + occurs in fracture. Fracture also contain hematite (Fe-oxides). Main minerals occurs in fracture + possibly in matrix of Tuff. Oxidized pyrites are visible. Matrix is also hematitic (dark red).

2/1/94 gp Samples for gamma spectromety: all sample are portions of whole rock (WRI) powders.

Sample	Wt of vial	Wt of vial+sample	Wt sample
NOPI-269-~~WRI~~ GAM1 gp	2.058 g	6.323 g	4.265 ~~4.622~~ g
NOPI-270-GAM1	2.071 g	6.033 g	3.962 g
NOPI-271-GAM1	2.071 g	6.379 g	4.308 g
NOPI-272-GAM1	2.068 g	5.906 g	3.838 g
NOPI-273-GAM1	2.059 g	6.385 g	4.326 g
NOPI-274-GAM1	2.064 g	6.318 g	4.254 g
NOPI-275-GAM1	2.069 g	6.124 g	4.055 g
NOPI-276-GAM1	2.060 g	6.123 g	4.063 g
NOPI-277-GAM1	2.068 g	5.987 g	3.919 g
NOPI-278-GAM1	2.070 g	5.970 g	3.900 g
NOPI-279-GAM1	2.067 g	6.357 g	4.290 g
NOPI-280-GAM1	2.076 g	6.232 g	4.156 g
NOPI-281-GAM1	2.054 g	6.540 g	4.486 g
NOPI-282-GAM1	2.066 g	6.526 g	4.460 g
NOPI-283-GAM1	2.062 g	6.604 g	4.542 g

Sample	Wt of vial	Wt of vial + sample	Wt of sample
NOPI-284-GAM1	2.092g	6.282g	4.210g
NOPI-285-GAM1	2.070g	6.269g	4.199g
NOPI-286-GAM1	2.065g	6.237g	4.172g
NOPI-287-GAM1	2.073g	6.184g	4.111g
NOPI-288-GAM1	2.073g	6.406g	4.333g
NOPI-289-GAM1	2.071g	5.576g	3.505g
NOPI-290-GAM1	2.070g	5.672g	3.602g
NOPI-291-GAM1	2.074g	7.013g	4.939g
NOPI-292-GAM1	2.070g	6.371g	4.301g
NOPI-293-GAM1	2.069g	6.580g	4.511g

2/9/94 JP Autoradiography of iron oxide bearing fracture (cont. from p. 87)

0800hrs About 200ml of 6N NaOH was placed in 3 500 ml plastic beakers. Beaker were placed in oven at 80°C and liquid was allowed 80°C

1400hrs Samples - thin sections:
NOPI-294-TS1
NOPI-301-TS1
NOPI-268-TS1
were removed from CR39 plastic and each plastic was placed in beaker containing 6N NaOH and placed in oven at 80°C for etching of alpha tracks.

1030hrs Samples were removed from oven. CR-39 plastics were removed from 6N NaOH and rinsed with Nanopure H_2O. Samples were allowed to air dry.

2/9/94 JJP Portions of whole rock powders were prepared for XRD analysis

NOPI-277-XRD1	portion of NOPI-277-WR1
NOPI-278-XRD1	portion of NOPI-278-WR1
NOPI-279-XRD1	portion of NOPI-279-WR1
NOPI-280-XRD1	portion of NOPI-280-WR1
NOPI-281-XRD1	portion of NOPI-281-WR1
NOPI-282-XRD1	portion of NOPI-282-WR1
NOPI-283-XRD1	portion of NOPI-283-WR1
NOPI-284-XRD1	portion of NOPI-284-WR1
NOPI-285-XRD1	portion of NOPI-285-WR1

2/1/94 JJP Fe-rich material (oxides + sulfates) from a sample NOPI-298 along the prominent E-W fracture on +10 mesh hand picked to separate from rock matrix. This material was powdered for XRD analysis and the sample labelled

NOPI-298-XRD2

2/9/94 JJP Portions of whole rock powders were prepared for XRD analysis

NOPI-286-XRD1	portion of NOPI-286-WR1
NOPI-287-XRD1	portion of NOPI-287-WR1
NOPI-288-XRD1	portion of NOPI-288-WR1
NOPI-289-XRD1	portion of NOPI-289-WR1
NOPI-290-XRD1	portion of NOPI-290-WR1
NOPI-291-XRD1	portion of NOPI-291-WR1
NOPI-292-XRD1	portion of NOPI-292-WR1
NOPI-293-XRD1	portion of NOPI-293-WR1

2/11/94 JP

Santorini Metal Analyses

Objective: determine metal content of Santorini rock samples by selective leaching experiments.

Method: selective leaching as outlined by Tessier et al 1979 (Anal. Chem. Vol 51 No 7 p844)

Preparation of powders:

Portions of the following rock samples were powdered in a SPEX mixer mill using a tungsten carbide vial.

SAN-023
SAN-030
SAN-038
SAN-046

Powders were placed in plastic vials & labeled as follows:

SAN-023-WR1
SAN-030-WR1
SAN-038-WR1
SAN-046-WR1

2/14/94 16:10 hrs gp About 10g of each of the Santorini whole rock powder samples were placed in labeled petri dishes and placed in the Thermolyne oven at 110°C.

2/15/94 1620 hrs gp
Santorini powders were removed from oven and placed in a dessicator.

2/16/94 gp

Preparation of metal standards

Using Cu, Ag, Sn, Zn, Pb, Co, Fe, and Mn atomic absorption reference standards (1000 ppm), 100 ppm standard solutions were made for the determination of metals in soils and Tuffs from Santorini Greece.

Materials:

1000 ppm Cu (lot NO 291648-24)
1000 ppm Ag (lot NO 932877-9)
1000 ppm Sn (lot NO 925284-24)
1000 ppm Zn (lot NO 932351-24)
1000 ppm Pb (lot NO 925795-24)
1000 ppm Co (lot NO 940162-24)
1000 ppm Fe (lot NO 922056-24)
1000 ppm Mn (lot NO 921488-24)

100 ml volumetric flasks
10 ml volumetric pipets
125 ml PP bottles

Procedure:

1) Rinse 10 ml pipet, then transfer 10 ml of AA solution standard into a 100 ml volumetric flask, dilute to mark with a solution of 1.5 ml HNO_3/1000 ml Nanopure water as the dilutant to maintain standard matrix
2) Transfer solution to a 125 ml PP bottle and label appropriately.
3) If necessary, serial dilutions or more dilutions can be made by following previous procedure.

* Note Zn standard was prepared in a 5% HNO_3 matrix and the Sn standard were prepared in a 10% HCl matrix to maintain original matrix.

2/17/94 JP Solution preparation for selective leach of Greece sample

1M $MgCl_2$ - added approximately 50.83 g of $MgCl_2 \cdot 6H_2O$ (lot 888152) to 200 ml H_2O in a volumetric flask. Dissolved solid by stirring then transferred solution to a 250 ml volumetric flask and added H_2O to mark. Sample transferred to 500 ml PP bottle and labeled "1M $MgCl_2 \cdot 6H_2O$"

1M NaOAc (pH=5.0) - Dissolved 68.04 g $NaOAc \cdot 3H_2O$ (lot 937077) in 500 ml H_2O in a 1L beaker. Add dropwise glacial HOAc (lot 933852) while monitoring pH until pH=5.0 is reached. Transfer solution to a 500 ml PP bottle labeled "1M NaOAc"

0.04M $NH_2OH \cdot HCl$ in 25% (v/v) HoAc -

- pipeted 125 ml glacial acetic acid (lot 933852) into a 500 ml volumetric flask. Added ~ 250 H_2O and mixed. Added 1.3858 g $NH_2OH \cdot HCl$ (lot 912653A) to the solution and made up to mark with H_2O. Transferred solution to a PP bottle labeled 0.04M $NH_2OH \cdot HCl$ in 25% (v/v) HoAc

2/21/94 gp

Triplicate ~1g samples of the Santorini rock powders were placed in platic 50ml centrifuge tubes and labeled as below

	wt tube gp	wt tube +powder	wt powder
SAN-023-A	13.763 ~~13.7623~~ g	14.764 g	1.001 g
SAN-023-B	13.697 ~~13.6976~~ g	14.738 g	1.041 g
SAN-023-C	13.696 ~~13.6968~~ g	14.712 g	1.016 g
SAN-030-A	13.671 ~~13.6735~~ g	14.694 g	1.023 g
SAN-030-B	13.912 ~~13.9148~~ g	14.923 g	1.011 g
SAN-030-C	13.610 ~~13.6133~~ g	14.644 g	1.034 g
SAN-038-A	13.737 g	14.755 g	1.018 g
SAN-038-B	13.745 g	14.786 g	1.041 g
SAN-038-C	13.924 g	14.954 g	1.030 g
SAN-046-A	13.628 g	14.654 g	1.026 g
SAN-046-B	13.890 g	14.912 g	1.022 g
SAN-046-C	13.667 g	14.693 g	1.026 g

~~Blank~~ gp 2/24/94

2/21/94 gp Leaching Procedure

1405hrs (1) 8 ml of 1M $MgCl_2$ was added to each centrifuge tube using an Oxford pipet. Samples were placed on a wrist shaker for ~1 hour.

1505hrs (2) Samples centrifuged at 10,000 rpm for ~30 min

1600hrs (3) ~7 ml of the supernatant was removed from tubes by pipeting and placed in labeled 15 ml PP bottles for later analysis

2/22/94 0800hrs (4) Samples were washed with deionized water by adding 8 ml of H_2O to each tube. Samples were then agitated on the homogenizer and centrifuged for 30 min at 10,000 rpm. The supernatant was then decanted.

0850hrs (5) 8 mls of 1M NaOAc was added to each tube using an Oxford pipet. Samples were agitated on wrist shaker for 5 hours.

1355hrs (6) Tubes were centrifuged for 30 min. at 10000 rpm

1440 (7) ~7ml of ~~the~~ supernatant was removed from tube by pipety & placed in labeled 15ml PP ~~bottle~~ for later analysis.

1450hrs (8) Samples were washed with DI H_2O by adding 8 ml of H_2O to each tube. Samples were then homogenized & centrifuged for 30 min at 10000 rpm. The supernatant was decanted. JP

2/23/94 JP

0800 hrs (9) 8 ml of 0.04 M $NH_2OH \cdot HCl$ in 25% (v/v) HOAc Reagent was added to each sample Tubes with an Oxford pipet. The tubes were then capped on a wrist shaker for 5 hours.

1300hrs (10) ~~JP~~ Tubes were centrifuged for 30 min at 10,000 rpm. JP

1330hrs (11) 27ml of the supernatant was removed from each sample tube + transferred to labeled 15 ml PP bottles for later analysis.

2/22/94 JJP XRD preparation of NOPI samples.

NOPI-302-XRD2 - Fe-rich fracture filling material, hand-picked and powdered for XRD analysis.

NOPI-303-XRD2 - Fe-rich fracture filling material, handpicked + powdered for XRD analysis.

NOPI-300-XRD2 - Fe-rich fracture fill material. handpicked + powdered for XRD analysis.

NOPI-299-XRD2 - Fe-rich fracture fill material. Handpicked + powdered for XRD analysis.

NOPI-296-XRD2 - Fe-rich fracture fill material. handpicked + powdered for XRD analysis.

NOPI-295-XRD2 - Fe-rich fracture fill material. Handpicked + powdered for XRD analysis

2/23/94 JJP

NOPI-203-XRD2 - Portion of NOPI-203-GAM1 (Fe-rich fracture fill material) taken for XRD analysis

NOPI-211-XRD2 - Fe-rich fracture fill material, handpicked + powdered + portion of NOPI-211-GAM1 taken for XRD analysis. About 50/50.

NOPI-210-XRD2 - Fe-rich fracture fill material, handpicked + powdered for XRD analysis

NOPI-146-XRD2 - Portion of NOPI-146-GAM1 (Fe-rich fracture fill material) taken for XRD analysis.

2/24/94 JJF Preparation of powders for gamma county in Div 01

	Vial wt	Vial+powder	Wt powder
NOPI-123-GAMZ	3.794g	4.802g	1.008g
NOPI-121-GAMZ	3.814g	4.818g	1.004g
NOPI-119-GAMZ	3.814g	4.823g	1.008g
NOPI-117-GAMZ	3.775g	4.779g	1.004g
NOPI-115-GAMZ	3.813g	4.833g	1.020g

The above powders are portions of previous gamma samples entered in 7ml PP vials counted on gamma spec in F. Iddings office.

3/7/94 JJF Preparation of whole rock powders for gamma analysis.

The following 4 samples are additional samples from a traverse perpendicular to the prominent fracture on +10 between 13+14 m E.

NOPI-392-WR1 is a subsample of NOPI-392 Limonite to hematite tuff. Kaolinite replaces feldspars in matrix & lines some fractures. Dark red iron-oxides also fill or line some fractures.
9.95/13.15/10 Wt = 25.43g

3/8/94 JJF NOPI-393-WR1 is a powdered subsample of NOPI-393. Kaolinitic/hematite tuff. Fe-oxides occur in both matrix and fractures
9.95/13.0/10 Wt = 23.18g

NOPI-394-WR1 is a powdered subsample of NOPI-394. Kaolinized/hematite/limonite altered tuff. Matrix appears variably hematized. Fractures contain red to orange/yellow Fe-oxides
9.95/13.80/0 Wt = 14.73g

NOPI-395-WR1 is a powdered subsample of NOPI-395. Hematite/limonite Kaolinized tuff. Matrix appears hematite (red colored). Limonite and hematite coat and fill fractures.
9.95/14.0/10 Wt = 20.09 g

Preparation of powders for gamma counting. Samples are portions of whole rock powders prepared previously.

	Vial wt	Vial + sample	Sample wt.
NOPI-392-GAM1	2.058 g	6.150 g	4.082 g
NOPI-393-GAM1	2.061 g	6.228 g	4.167 g
NOPI-394-GAM1	2.068 g	5.969 g	3.901 g
NOPI-395-GAM1	2.066 g	6.384 g	4.318 g

3/8/94 JP

Preparation of whole rock powders

Samples from +0 level tabu within the vitrophyre adjacent to Nopal I orebody.

NOPI-371-WR1 is a powdered subsample of NOPI-371. Gray green silicate rock. May be clay intergrown with zeolite. Abundant Fe-oxide staining.
Wt = 18.82 g

3/9/94 JP

NOPI-370-WR1 is a powdered subsample of NOPI-370 Black, yellow, orange Fe-rich vein filling material. Yellow U? minerals are common as a coating on the Fe-oxides.
Wt = 8.98 g

NOPI-369-WR1 is a powdered subsample of NOPI-369 White to gray-green clay altered vitrophyre. Some iron (orange yellow) staining.
Wt = 15.11 g

NOPI-368-WR1 is a powdered subsample of NOPI-368. White green clay altered vitrophyre
Wt = 23.57 g

3/8/94 JP

Santorini leaching experiment -
Results of ~~All~~ analyses of samples leached previously (P111-11B) indicate that additional solution will be required to analyze for all the metals of interest.

Therefore, the leaching procedure will be rerun. However, for each rock powder, 6 1g samples will be leached instead of 3 1g samples.

6 1g samples of Santorini rock powders SAN-023 and SAN-046 were placed in 50 ml centrifuge tubes and labeled as below

	wt tube	wt tube + powder	wt powder
SAN-023-A	13.711 g	14.727 g	1.016 g
SAN-023-B	13.778 g	14.797 g	1.019 g
SAN-023-C	13.655 g	14.682 g	1.027 g
SAN-023-D	13.708 g	14.730 g	1.022 g
SAN-023-E	13.669 g	14.700 g	1.031 g
SAN-023-F	13.830 g	14.847 g	1.017 g
SAN-046-A	13.777 g	14.790 g	1.013 g
SAN-046-B	13.714 g	14.737 g	1.023 g
SAN-046-C	13.674 g	14.704 g	1.030 g
SAN-046-D	13.980 g	15.004 g	1.024 g
SAN-046-E	13.803 g	14.826 g	1.023 g
SAN-046-F	13.715 g	14.736 g	1.021 g

3/9/94 JP Leaching Procedure

0845hr ① Added 8 ml of 1M $MgCl_2$ to each centrifuge tube and placed on wrist shaker for 1 hr.

1000hr ② Centrifuged tubes at 10,000 rpm for 30 min

1040hr ③ ~7 ml of the supernatant was removed by pipety and placed in a labeled 60 ml PP bottle for later analysis.

Bottle labels =
SAN-023 $MgCl_2$
SAN-046 $MgCl_2$

1045hr ④ Samples were washed with DI water by addi 8 ml H_2O to each tube, agitated on homogenizer and centrifuged at 10000 rpm for 30 min. Supernatant was then decanted.

3/10/94 JP

0815hr ⑤ Added 8 ml of 1M NaOAc to each centrifuge tube & placed on wrist shaker for 5 hrs.

1325hr ⑥ Tubes centrifuged at 10,000 rpm for 30 min

1400hr. ⑦ ~7 ml of supernatant removed by pipety & placed in labeled 60 ml pp bottles

Bottle labels =
SAN-023 NaOAc
SAN-046 NaOAc

1420hr ⑧ Samples washed with DI water by adding 8 ml H_2O to each tube, agitating & centrifuging at 10000 rpm for 30 min. Supernatant was then decanted. (cont on page 125)

3/9/94 JP NOPI-371-XRD1 - part of NOPI-371-WR1 for XRD analysis

3/9/94 JP Prepared addition 1M $MgCl_2 \cdot 6H_2O$ for leaching experiment.

Added ~101.66 g of $MgCl_2 \cdot 6H_2O$ (lot 936845) to 400 ml H_2O in a volumetric ~~flask~~ beaker. Dissolved solid and transferred solute to a 500 ml volumetric flask. Added H_2O to mark & transferred soln to a 500 ml PP bottle labeled "1M $MgCl_2 \cdot 6H_2O$"

3/9/94 JP Preparation of whole rock powders

Additional samples from top level taken with the petrologic object to NOPI and ourself.

NOPI-331-WR1 is a powdered subsample of NOPI-331. Red/purple clay altered ultrabyte. Minor white clay. Some orange Fe-oxide staining.
Wt = 20.05 g

NOPI-367-WR1 is a powdered subsample of NOPI-367. Black & orange Fe-oxide rich material. Trace yellow unknown mineral present.
Wt = 12.75 g

3/10/94 JP NOPI-366-WR1 is a powdered subsample of NOPI-366. Tan-yellow unconsolidated clay altered ultrabyte. Some minor dark Fe-oxide.
Wt = 14.1 g

NOPI-365WR1 is a powdered subsample of NOPI-365. White-green-gray clay altered ultrabyte. Some minor Fe-oxide and unknown yellow mineral present. Competent - may contain zeolite.
Wt = 14.3 g

NOPI-364-WRI is a powdered subsample of NOPI-364. Orange gray limonite fracture fill material.
Wt = 17.6g

NOPI-363-WRI is a powdered subsample of NOPI-363. Dark Fe-rich material from fracture. Also contains orange Fe-oxide (limonite coat). Yellow unknown mineral also present.
Wt = 15.1g

NOPI-330-WRI is a powdered subsample of NOPI-330. Clay altered ultramafic. White-gray-green material.
Wt = 20.6g

NOPI-332-WRI is a powdered subsample of NOPI-332. White-yellow-tan clay altered ultramafic. Unmineralized.
Wt = 18.0g

Leaching Procedure Cont.

3/11/94 0805hrs (9) Added 8 ml of 0.04M $NH_2OH \cdot HCl$ in 25% (v/v) HOAc to each centrifuge tube and placed on wrist shaker for 5 hrs.

1310hrs (10) Tubes centrifuged at 10000 rpm for 30 min

(11) ~7 ml of supernatant removed by pipet + placed in labeled 60 ml ~~bottle~~ PPL bottle

Bottle labels

SAN-023	NH_2OH
SAN-046	NH_2OH

3/11/94 JP Prepuruptn of whole rock powders

Additional samples from +0 level with vitroplyz

NOPI-333-WR1 is a powdered subsample of NOPI-333. White-tan-grey friable clay-zeolite. Contains inclusion yellow mineral on surface. Fairly competent.
Wt = 16.8 g

NOPI-334-WR1 is a powdered subsample of NOPI-334. Orange-black iron rich material from fracture.
Wt = 17.0g

NOPI-335-WR1 is a powded subsample of NOPI-335. Red/purple unconsolidated clay altered vitroplyz
Wt = 18.1 g

NOPI-336-WR1 is a powded subsample of NOPI-336. White-tan-grey clay altered vitroplyz. Unconsolidated
Wt = 17.7 g

NOPI-337-WR1 is a powded subsample of NOPI-337. Red/purple clay altered vitroplyz. Fairly consolidated
Wt = 19.0 g

3/11/94 JP

The following procedure will be used to prepare clay mounts of samples from Wagpal ☐ for XRD analysis. These analyses will be used to determine the mineralogy of clay minerals.

Procedure for preparing clay mounts for XRD analysis:

crushed bulk rock JP 3/15/94

1. Take 3 to 5 g of ~~milled whole rock powder~~ and place in a 500 ml volumetic beaker.

33g Sodium Metaphosphate + 7g Sodium carbonate in 1L of H_2O; 50ml of this soln to 1000 ml H_2O. JP

2. Add about 200 ml of sodium hexametaphosphate solution ~~(5g/L)~~ to the beaker and ultrasonically clean for about 10 min to disperse sample.

3. Pour about 45 ml of the solution into 4 centrifuge tubes (50 ml) and centrifuge at 1300 rpm for 2 minutes.

4. Decant supernatant (<2μm).

5. Sieve supernatant through a 0.45 membrane filter and transfer to a glass slide. Make 4 separate samples (air dry, glycolate at 60°C for 1 hour, heat at ~~400°C~~ 375°C for 30 minutes, and heat at 550°C for 30 minutes). JP

Sample glass slides will be labeled as follows:

Sample # - AD (ie. NOPI-369-AD)
" - 400°C
- 550°C
- GLY

3/11/94 Preparation of whole rock powders for gamma analysis.
Samples consist of portions of whole rock (WRI) powders prepared previously.

	Vial wt	Vial+Sample	Sample wt
NOPI-330-GAM1	2.087g	6.355g	4.268g
NOPI-331-GAM1	2.076g	6.318g	4.242g
NOPI-332-GAM1	2.077g	6.186g	4.109g
NOPI-333-GAM1	2.073g	5.681g	3.608g
NOPI-334-GAM1	2.076g	6.364g	4.288g
NOPI-335-GAM1	2.068g	6.121g	4.053g
NOPI-336-GAM1	2.055g	6.063g	4.008g
NOPI-337-GAM1	2.073g	6.132g	4.059g
NOPI-363-GAM1	2.076g	6.052g	3.976g
NOPI-364-GAM1	2.058g	6.186g	4.128g
NOPI-365-GAM1	2.074g	6.193g	4.119g
NOPI-366-GAM1	2.059g	6.952g	4.893g
NOPI-367-GAM1	2.069g	6.720g	4.651g
NOPI-368-GAM1	2.066g	6.481g	4.415g
NOPI-369-GAM1	2.063g	6.311g	4.248g

NOPI-370-GAM1	2.068g	6.721g	4.653g
NOPI-371-GAM1	2.068g	5.952g	3.884g

All samples were dried in an oven at 100°C for at least 24 hours before placing into vials.

3/11/94
NOPI-333-XRD2 – yellow unknown mineral handpicked & powdered for XRD analysis. Probably opal/clay.

3/14/94 gp Thin section blocks for samples NOPI-414 and NOPI-416 were cut and sent to Mineral Optics for preparation of polished thin sections

The order form is shown below.

Mineral Optics Laboratory
P.O. Box 828
Wilder, Vermont 05088
29 "A" Street
(802) 295-9373

PETR
ORDER CH.

(210) 522-5540

Bill To: ENGLISH PEARCY
Address:
City, State, ZIP

Ship To: ENGLISH PEARCY
Address: 6220 Culebra Rd
SwRI / BLDG. 57
City, State, ZIP SAN ANTONIO TX 78238

Date
Order No.
Customer P.O.
Received
Shipped
Phone 516
Shipped via

Sample No.	Size (Quantity; 27 x 46 mm; 1.5 x 3 in.; 2 x 3 in.; 1" or 1.25 dia.; Other; Thick ___ mm; Thin ___ mm; Standard .03 mm)	Finish (Std Lapped; 1 Side Polish; 2 Side Polish)	Impreg. (Clear Resin; Color Resin)	Stain (Grains, Cutting; Carbonate; Feldspar)	Cut (Bulk Sample; Oriented)	Other (Other Cement; Water Soluble; W/Cover Glass; No Cover Glass)	Discard Mail
NOPI-416-1	STANDARD	POLISHED THIN Section from AEA WITH NO WRITING					
NOPI-414-1	SAME AS ABOVE						

RUSH

The thin sections were received and labeled as follows:

NOPI-414-TS1
NOPI-416-TS1

3/14/94 JP

Thin sections, a UO_2 standard, and photos of thin sections were sent to Ray Guillemette at Texas A+M for microprobe analyses of uranium moving diffusion from Fe-oxide filled fractures and uranium content of phases and materials in Fe-rich fractures.

3 thin sections were sent:

NOPI-414-TS1 (matrix diffusion analyses)

NOPI-294-TS1 (U content of mineral
NOPI-301-TS1 phases + material in fractures)

Opposite is letter sent to A+M explaining analyses to be done.

Center for Nuclear Waste Regulatory Analyses

6220 CULEBRA ROAD • P.O. DRAWER 28510 • SAN ANTONIO, TEXAS, U.S.A. 78228-0510
(210) 522-5160 • FAX (210) 522-5184

March 14, 1994

Dr. Ray Guillemette
Department of Geology
Texas A&M University
Halbouty Bldg.
College Station, Texas 77843

Dear Ray,

Enclosed are thin sections, the UO_2 standard, and photos for analyses of samples from the Nopal I uranium deposit in Chihuahua, Mexico. The thin sections consist of fractures which contain crystalline and amorphous Fe-oxides, jarosite (an Fe, K sulfate), kaolinite, and fragments of the host rock. Gamma spectrometry indicates that the fracture-filling materials contain uranium (bulk analyses range from 200-2000 ppm U) and suggests that the fracture is a major pathway for transport of uranium away from the uranium orebody. Autoradiographic analyses of thin sections shows that uranium also moves from the fracture into the matrix of the tuff.

As we discussed on the phone last week, English Pearcy and I would like to determine within or on what mineral(s) or material(s) uranium is sited and how far and how much uranium diffuses into the matrix of the host tuff.

Initially, we would like you to test whether the sensitivity of the microprobe is able to detect uranium. If so, three types of analyses can be attempted:

1). Matrix diffusion (thin section NOPI-414-TS1). Traverses starting with fracture filling Fe-oxide material and moving into the host tuff. Density of analyses should be greatest at contact between Fe-oxide and host tuff. We expect uranium content to drop rapidly as it diffuses into the matrix (micron scale). Size of beam as small as possible (1 μm).

2). Siting of uranium within fractures (thin sections NOPI-294-TS1 and NOPI-301-TS1). Analyses of phases within fracture to determine if U is associated with a particular mineral or material.

3). Uranium mapping (same areas on thin sections as in 1 and 2). Show relative abundance of U away from fractures into matrix and location and relative abundance of U with respect to different phases within a fracture.

Washington Office • Crystal Gateway One, Suite 1102 • 1235 Jefferson Davis Hwy. • Arlington, Virginia 22202-3293

Thin sections are accompanied by photos that define sites that are good candidates for analysis:

NOPI-414-TS1 (not carbon coated) - includes composite (10X) photo of the side of the thin section with the fracture filling Fe-oxide and a composite (50X) photo showing approximate traverse paths. Try to avoid any obvious microfractures and Fe-oxides in the host tuff.

NOPI-294-TS1 (already carbon coated) - includes composite photo (10X) of thin section and 4X5 photos showing sites 1 and 3 on the composite.

NOPI-301-TS1 (already carbon coated) - includes composite photo (10X) of thin section and 4X5 photos showing sites 2 and 5 on the composite.

Please spend about 16 to 20 hours doing the analyses. Of course, this may not allow you the time needed to complete all the analyses defined above, however we would like to review the results before committing to additional work.

My I.P. address for transferring files is 129.162.209.103. I will give you a call later this week to see if you have any questions. Good luck!

Sincerely,

James C. Prikryl

James D. Prikryl
210-522-5667

3/15/94 JP Scotsini leaching:

Additional samples prepared for trace element analysis by leaching.

6 1g samples of rock powders SAN-030-WR1 & SAN-038-WR1 were placed in 50 ml centrifuge tubes & labeled as before:

	wt tube	wt tube + powder	wt powder
SAN-030-A	13.787 g	14.810 g	1.023 g
SAN-030-B	13.775 g	14.797 g	1.022 g
SAN-030-C	13.763 g	14.785 g	1.022 g
SAN-030-D	13.726 g	14.745 g	1.019 g
SAN-030-E	13.813 g	14.838 g	1.025 g
SAN-030-F	13.753 g	14.776 g	1.023 g
SAN-038-A	13.670 g	14.692 g	1.022 g
SAN-038-B	13.723 g	14.744 g	1.021 g
SAN-038-C	13.383 g	14.397 g	1.014 g
SAN-038-D	13.548 g	14.581 g	1.033 g
SAN-038-E	14.119 g	15.137 g	1.018 g
SAN-038-F	13.435 g	14.469 g	1.034 g

3/15/94 JP 0855 hrs Leaching procedure on p 121 and 125 was followed

Sample labels:

SAN-030 - $MgCl_2$
SAN-038 $MgCl_2$
SAN-030 $NaOAc$
SAN-038 $NaOAc$
SAN-030 NH_2OH
SAN-038 NH_2OH

3/15/94 gp Preparation of Santorini whole rock powders.

SAN-053-WR1 is a powdered subsample of SAN-053. Cape Riva tuff, purple tuff with lithic fragments. Will provide baseline mineralogy & chemistry. Wt = 15.0 g

SAN-034-WR1 is a powdered subsample of SAN-034. Bedrock fragments with skyline with white coatings. Wt = 13.1 g

3/16/94 gp Prepare clay mounts following procedure on p 127 for the following samples:

	Clay mount labels -
NOPI-369-CM1	NOPI-369-AD, NOPI-369-GLY, NOPI-369-375°C, NOPI-369-550°C
NOPI-371-CM1	NOPI-371-AD, NOPI-371-GLY, NOPI-371-375°C, NOPI-371-550°C

Labels reflect clay material that was hand-crushed to prepare the clay mounts. This material will be dried and placed in plastic vials.

(Note, these glass slides were not saved, i.e. clay material was removed & not saved).

3/17/94 gp About 10 g of Santorini whole rock powders SAN-034-WR1 and SAN-053-WR1 were placed in glass dishes & placed in the Thermolyne oven at 110°C for drying.

3/17/94 gp

Preparation of whole rock powders
These samples are from level 0
of Nopal I and are from an
apparent N-S trending from the
ore body into very weathered,
clay altered tuff.

NOPI-308-WR1 is a powdered
subsample of NOPI-308. Hematite
somewhat silicified tuff. Dark (red to
black) Fe-oxides coat + fill
fractures. Feldspars in matrix are
altered to Kaolinite. Some minor
yellow uranium mineral opite in
fractures. Wt = 14.1 g

NOPI-309-WR1 is a powdered subsample
of NOPI-309 Hematite/limonite tuff.
Feldspar replaced by Kaolinite. Dark
(red + black) Fe oxides coat +
fill fractures. May contain some
uranyl silicates in fractures.
Wt = 18.5 g

3/18/94 gp

Santorini leaching:

6 1g sample of rock powders SAN-034
and SAN-053 were placed in 50 ml
centrifuge tubes for leaching of trace
metals. Tubes were labeled as below:

	wt tube	wt tube + powder	wt powder
SAN-034-A	13.956 g	14.977 g	1.021 g
SAN-034-B	13.743 g	14.763 g	1.020 g
SAN-034-C	13.670 g	14.682 g	1.012 g
SAN-034-D	13.632 g	14.641 g	1.011 g
SAN-034-E	13.786 g	14.776 g	0.990 g
SAN-034-F	13.893 g	14.894 g	1.001 g
SAN-053-A	13.798 g	14.802 g	1.004 g
SAN-053-B	13.719 g	14.727 g	1.008 g
SAN-053-C	13.777 g	14.776 g	0.999 g
SAN-053-D	13.824 g	14.834 g	1.010 g
SAN-053-E	13.757 g	14.763 g	1.006 g
SAN-053-F	13.829 g	14.852 g	1.023 g

Leach procedure on p121 and p125 was
followed:

Samples labeled as follows:

SAN-034 $MgCl_2$
SAN-053 $MgCl_2$
SAN-034 NaOAc
SAN-053 NaOAc
SAN-034 NH_2OH
SAN-053 NH_2OH

3/18/94 Preparation of whole rock powders (cont)

NOPI-310-WR1 is a powdered subsample of NOPI-310. Hematitic altered tuff. Dark Fe-oxides fill + coat fractures. Matrix of tuff appears hematized. No visible U minerals.
Wt = 13.5 g

NOPI-311-WR1 is a powdered subsample of NOPI-311. Broken Fe rich tuff. Hematized tuff matrix. Fe-oxides line + fill fractures. No visible U minerals. Clay replaces feldspars.
Wt = 18.1 g

3/21/94pp NOPI-312-WR1 is a powdered subsample of NOPI-312. Hematitic/kaolinite tuff. Black Fe-oxides coat and fill fractures. Matrix does not appear very hematitic (tan color)
Wt = 21.9 g

NOPI-313-WR1 is a powdered subsample of NOPI-313. Hematitic/kaolinite altered tuff. Black + red Fe-oxides coat + fill fractures. Kaolinite. No visible U minerals.
Wt = 23.1 g

3/21/94pp XRD sample preparation

NOPI-333-XRD1 - portion of whole rock powder.

NOPI-371-XRD2 - transparent mineral handpicked from fracture surfaces of bulk rock. Often intergrown with white fine material which may be kaolinite. White material may also be weathering product of the transparent mineral. All powder added as internal reference

NOPI-144-XRD2 - portion of NOPI-144-GAM1. Fe-oxide rich material.

NOPI-142-XRD2 - portion of NOPI-142-GAM1. Fe-oxide rich material.

NOPI-138-XRD2 - portion of NOPI-138-GAM1. Fe-oxide rich material.

NOPI-140-XRD2 - Hand picked Fe-oxides from bulk sample + portion of NOPI-140-GAM1.

3/21/94 JP Prep. of whole rock powders (cont)

NOPI-314-WR1 is a powdered subsample of NOPI-314. Hematite/limonite altered tuff. Feldspar replaced by kaolinite. No visible U minerals. Dark red & black Fe-oxide coat and fill fractures.
Wt = 14.5 g

NOPI-315-WR1 is a powdered subsample of NOPI-315. Hematite/limonite altered tuff. Feldspar replaced by kaolinite. Black + red Fe-oxide coat + fill fractures. No visible U minerals.
Wt = 19.9 g

NOPI-316-WR1 is a powdered subsample of NOPI-316. Hematite/limonite altered tuff. Appears clay rich - may have some weathering. Feldspar replaced by kaolinite. Dark Fe-oxides occur in fractures.
Wt = 25.9

NOPI-317-WR1 is a powdered subsample of NOPI-317. Hematite/limonite altered tuff. Dark (red + black) Fe-oxides coat and fill fractures. No visible U minerals.
Wt = 22.1 g

NOPI-318-WR1 is a powdered subsample of NOPI-318 limonite/hematite altered tuff. Black + red Fe-oxides coat surfaces of boxwork tuff. Kaolinite replaces feldspars. No visible U minerals.
Wt = 19.5 g

3/22/94 JP NOPI-319-WR1 is a powdered subsample of NOPI-319. Clay altered Tuff (weathering) Fe-oxides common - coat surfaces of tuff fragments.
Wt = 27.8 g

NOPI-320-WR1 is a powdered subsample of NOPI-320. Appears to be weathered clay-altered tuff (maybe vitrophyre). Fe-oxide rich coat surfaces of altered tuff.
Wt = 25.9 g

NOPI-321-WR1 is a powdered subsample of NOPI-321. Clay altered material. Tan colored. Less Fe-oxide than previous sample. Friable-incoherent when wet.
Wt = 16.3 g

NOPI-322-WR1 is a powdered subsample of NOPI-322. Clay altered material (weathered tuff or vitrophyre?) Fairly consolidated. Fe-oxides coat fracture surfaces.
Wt = 16.2 g

NOPI-323-WR1 is a powdered subsample of NOPI-323. Clay altered material. White grey in color. Contains some Fe-oxides as coatings. Unconsolidated + friable.
Wt = 19.2 g

NOPI-324-WR1 is a powdered subsample of NOPI-324. Fairly unconsolidated clay altered material. Fe-oxides occur as coatings + some nodules.
Wt = 24.5 g

NOPI-325-WR1 is a powdered subsample of NOPI-325. Unconsolidated, friable clay altered material. Black Fe/Mn oxides throughout sample. Some hard consolidated fragments.
Wt = 25.1 g

NOPI-326-WR1 is a powdered subsample of NOPI-326. Clay altered material. Fe/Mn oxides (black) occur throughout sample. Some unconsolidated material along with consolidated chunks. Yellow Fe-oxide common on surfaces of chunks.
Wt = 27.8 g

3/23/94 gp

NOPI-327-WR1 is a powdered subsample of NOPI-327. Clay altered material. White in color with abundant black Fe/Mn oxides throughout. Some yellow limonitic staining.
Wt = 25.4 g

NOPI-328-WR1 is a powdered subsample of NOPI-328. Mostly unconsolidated clay altered material. Grey-tan color with black Fe/Mn oxides throughout. Some yellow limonite staining.
Wt = 27.8 g

NOPI-329-WR1 is a powdered subsample of NOPI-329. Mostly unconsolidated clay altered mineral. Tan colored. Black Fe/Mn oxides throughout. Some yellow limonite staining.
Wt = 28.9 g

3/23/94 JP AA analysis of Sartorini leachates.

① Cu, Ag, Co, Pb, ad Zn are analyzed by ~~Standard~~ additin method to avoid matrix interferences.

For each sample leachate, 5 ml of sample were placed in 3 10ml Volumetric flasks using an Oxford pipet.

Additions of the 100 ppm element standards were then made accordg to the tables below: ml added/ppm

Element	Volumetric Flask A	B	C
Cu	0/0	.1/1	.2/2
Ag	0/0	.1/1	.2/2
Co	0/0	.1/1	.2/2
Pb	0/0	.1/1	.2/2
Zn	0/0	.05/.5	.1/1

Solutions samples were ~~then~~ made up to mark in flasks with the 1.5 m HNO_3/1L H_2O. Final ppm values are shown in above table.

Samples were then analyzed by AA using the 3100 Perkin Elmer.

② Fe and Mn are analyzed using standard calibration curve procedure.

Sample leachates were diluted as shown below.

~~ml added/ppm~~

		sample ml added/final vol
$MgCl_2$ leachate	1/10	
NaOAc leachate	1/10	
NH_2OH leachate	1/25	

Samples were then analyzed by AA using the 3100 Perkin Elmer.

Calculations, raw data, graphs are kept in 3 ring binder entitled "Trace Metal Leaching Data, Sartorini Green."

3/28/94 JP *Note

Due to matrix interferences in the Fe + Mn analyses which resulted in questionable results, Fe + Mn were analyzed by standard addition method.

Sample leachates were again diluted by the factors as above: $MgCl_2$ 1/10; NaOAc 1/10; and NH_2OH 1/25.

Additions of 100 ppm standards were made according to below table. ml added / ppm

	Flush (10 ml)			(25 ml)	
	A	B	C	B	C
Fe	0/0	.1/1	.2/2	.25/1	.5/2
Mn	0/0	.05/.5	.1/1	.125/.5	.25/1

Samples were analyzed by AA on 3100 Perkin Elmer.

Santorini Leaching Results

SAMPLE NO.	MgCl2 exchangeable								Carbonate fraction								Fe-Mn oxides							
	Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn	Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn	Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn
Profile																								
SAN-023	1.16	1.01	2.75	3.91	0.71		0.84	9.64	1.88	0.85	3.22	5.05	0.79		4.80	20.16	2.47	0.51	5.22	4.12	5.30		39.06	117.94
SAN-030	0.84	0.85	4.13	2.11	0.58		1.96	2.48	1.87	0.82	4.04	6.14	1.28		0.90	10.43	1.11	0.04	1.85	7.53	2.20		101.68	24.50
SAN-038	1.01	0.73	5.12	4.01	0.32		1.15	2.34	1.67	0.54	3.82	4.15	1.94		0.00	10.98	0.88	0.13	1.32	7.52	1.73		99.14	16.17
SAN-046	0.73	0.58	5.55	3.47	0.26		1.13	3.55	1.50	0.35	3.27	3.55	2.15		2.97	9.08	0.57	0.65	1.18	5.88	1.54		105.60	17.74
Base Chemistry																								
SAN-053	0.86	0.67	8.62	2.00	0.76		5.17	5.04	1.13	0.65	6.26	1.87	2.64		14.52	9.42	0.84	0.55	2.49	2.29	2.69		174.29	11.59
White coating in fractures																								
SAN-034	0.95	0.73	5.59	2.52	0.16		1.32	3.61	2.37	0.60	8.45	7.53	1.65		25.44	13.96	2.36	0.25	2.20	7.00	4.20		211.89	17.03

3/30/94 Above are results of leaching exp. Tin (Sn) will be analyzed when AA (imp arrives (Sn lamp ordered 3/29/94)

3/28/94 gp Preparation of whole rock powders - Santorini.

Portions of the following bulk rock samples were powdered in a SPEX mixer mill with a tungsten carbide vial and labeled as follows

	Wt.
SAN-027-WR1	55.2g
SAN-033-WR1	48.1g
SAN-041-WR1	45.8g
SAN-049-WR1	47.1g

(~10g)
Samples were placed petri dishes and placed in oven at 100°C for drying overnight.

3/28/94 JP Prepared powders for gamma analysis
Samples consist of portions of whole rock powders (WEI) prepared previously

	Wt vial	Wt vial + sample	Wt sample
NOPI-308-GAM1	2.060g	6.413g	4.340g
NOPI-309-GAM1	2.073g	6.275g	4.202g
NOPI-310-GAM1	2.063g	6.149g	4.086g
NOPI-311-GAM1	2.056g	6.324g	4.268g
NOPI-312-GAM1	2.075g	6.040g	3.965g
NOPI-313-GAM1	2.075g	6.256g	4.181g
NOPI-314-GAM1	2.064g	6.388g	4.324g
NOPI-315-GAM1	2.072g	6.330g	4.258g
NOPI-316-GAM1	2.056g	6.295g	4.239g
NOPI-317-GAM1	2.069g	6.283g	4.214g
NOPI-318-GAM1	2.083g	6.346g	4.263g
NOPI-319-GAM1	2.074g	5.941g	3.867g
NOPI-320-GAM1	2.056g	5.839g	3.783g
NOPI-321-GAM1	2.056g	5.872g	3.816g
NOPI-322-GAM1	2.073g	5.673g	3.600g

NOPI-323-GAM1	2.072g	5.848g	3.776g
NOPI-324-GAM1	2.078g	6.028g	3.950g
NOPI-325-GAM1	2.068g	6.206g	4.138g
NOPI-326-GAM1	2.059g	6.313g	4.254g
NOPI-327-GAM1	2.074g	6.040g	3.966g
NOPI-328-GAM1	2.055g	5.949g	3.894g
NOPI-329-GAM1	2.071g	6.180g	4.109g

3/29/94 gp Santorini leaching:

Additional samples prepared for trace element analysis by selective leaching:

6 1g samples of rock powders SAN-027-WR1 and SAN-041-WR1 were placed in labeled 50 ml centrifuge tubes & labeled as below

	wt tube	wt tube + sample	wt sample
SAN-027-A	13.818g	14.826g	1.008g
SAN-027-B	13.759g	14.773g	1.014g
SAN-027-C	13.791g	14.808g	1.017g
SAN-027-D	13.777g	14.785g	1.008g
SAN-027-E	13.980g	14.996g	1.016g
SAN-027-F	13.916g	14.933g	1.017g
SAN-041-A	13.802g	14.820g	1.018g
SAN-041-B	13.767g	14.786g	1.019g
SAN-041-C	13.726g	14.732g	1.006g
SAN-041-D	13.695g	14.717g	1.022g
SAN-041-E	13.843g	14.852g	1.009g
SAN-041-F	13.711g	14.729g	1.018g

Leaching procedure on pgs. 121 & 125 was followed.
Sample labels:

SAN-027 $MgCl_2$
SAN-041 $MgCl_2$
SAN-027 $NaOAc$
SAN-041 $NaOAc$
SAN-027 NH_2OH
SAN-041 NH_2OH

4/1/94 gp Prepared clay mounts following procedure on p127 for the following samples:

NOPI-322-CM1 - hand-crushed material (bulk rock) used to prepare clay mounts.

Clay mounts: NOPI-322-AD
NOPI-322-GLY
NOPI-322-375C
NOPI-322-550C

NOPI-331-CM1 - hand-crushed bulk rock used to prepare clay mounts.

Clay mounts: NOPI-331-AD
NOPI-331-GLY
NOPI-321-375C
NOPI-331-550C

NOPI-328-CM1 - hand crushed clay material used to prepare clay mounts.

Clay mounts: NOPI-328-AD
NOPI-328-GLY
NOPI-328-375C
NOPI-328-550C

4/4/94 JP Santorini Leachy

Additional samples prepared for trace element analysis by selective leachy.

6 1g samples of rock powders SAN-033-WR1 and SAN-049-WR1 were placed in 50 ml centrifuge tubes + labeled as below:

	wt tube	wt tube + sample	wt sample
SAN-033-A	13.680g	14.706g	1.026
SAN-033-B	13.605g	14.628g	1.023
SAN-033-C	13.744g	14.757g	1.013
SAN-033-D	13.865g	14.848g	0983
SAN-033-E	14.006g	15.014g	1.008
SAN-033-F	13.785g	14.805g	1.020
SAN-049-A	13.766g	14.776g	1.010
SAN-049-B	13.845g	14.856g	1.011
SAN-049-C	13.984g	15.609g	1.025
SAN-049-D	13.736g	14.756g	1.020
SAN-049-E	13.752g	14.772g	1.020
SAN-049-F	13.762g	14.778g	1.016

Leachy procedure on pp 124 + 125 was followed.

Sample labels:

SAN-033	$MgCl_2$
SAN-049	$MgCl_2$
SAN-033	$NaOAc$
SAN-049	$NaOAc$
SAN-033	NH_2OH
SAN-049	NH_2OH

4/4/94 JP Preparation of whole rock powders - Santorini

Portions of the following bulk rock samples were powdered and labelled as below.

	wt.
SAN-022-WR1	59.1g
SAN-029-WR1	44.9g
SAN-037-WR1	50.1g
SAN-045-WR1	41.2g

~10g of each powder were placed in petri dishes and placed in an oven at 100°C for drying

4/4/94 gp XRD preparation - portions of the following whole rock powders were prepared for XRD analysis

NOPI-369-XRD1 - portion of NOPI-369-WR1

4/5/94 gp ~~NOPI-371-XRD1 - portion of NOPI-371-WR1~~

NOPI-322-XRD1 - portion of NOPI322-WR1

NOPI-328-XRD1 - portion of NOPI-328-WR1

NOPI-331-XRD1 - portion of NOPI-331-WR1

XRD preparation

NOPI-134-XRD2 - all of NOPI-134-GAM1

NOPI-136-XRD2 - all of NOPI-136-GAM1

4/6/94 gp AA analysis of Santorini leachates

Procedure and dilution factors are same as on pp 146-148.

Data + graphs are kept in 3-ring binder entitled "Trace Metal Leach Data, Santorini Greece".

Results of leaching thus far are shown below.

Santorini Leaching Results

SAMPLE NO.	MgCl2 exchangeable								Carbonate fraction								Fe-Mn oxides							
	Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn	Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn	Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn
Profiles																								
(Hole III)																								
SAN-023	1.16	1.01	2.75	3.91	0.71		0.84	9.64	1.88	0.85	3.22	5.05	0.79		4.80	20.16	2.47	0.51	5.22	4.12	5.30		39.06	117.94
SAN-030	0.84	0.85	4.13	2.11	0.58		1.96	2.48	1.87	0.82	4.04	6.14	1.28		0.90	10.43	1.11	0.04	1.85	7.53	2.20		101.68	24.50
SAN-038	1.01	0.73	5.12	4.01	0.32		1.15	2.34	1.67	0.54	3.82	4.15	1.94		0.00	10.98	0.88	0.13	1.32	7.52	1.73		99.14	16.17
SAN-046	0.73	0.58	5.55	3.47	0.28		1.13	3.55	1.50	0.35	3.27	3.55	2.15		2.97	9.08	0.57	0.65	1.19	5.88	1.54		105.60	17.74
(Hole VI)																								
SAN-027	0.79	0.70	2.91	3.35	0.32		3.75	3.71	1.45	1.24	2.84	2.33	0.88		2.31	15.13	3.12	0.36	6.27	2.46	5.02		39.09	101.79
SAN-033	0.62	0.50	3.80	3.57	0.52		5.88	1.26	1.83	0.57	2.68	3.10	2.31		0.18	10.79	1.39	0.00	1.08	2.04	3.04		120.36	24.31
SAN-041	0.44	0.41	3.25	3.04	0.39		5.09	2.19	1.45	0.21	2.22	3.21	1.71		0.00	8.54	0.63	0.00	0.95	2.65	1.35		100.87	10.52
SAN-049	0.44	0.20	2.88	2.88	0.67		4.29	1.23	1.95	0.66	2.70	3.13	1.74		0.53	8.49	0.58	0.00	0.95	1.69	1.46		99.15	11.64
Base Chemistry																								
SAN-053	0.86	0.67	8.62	2.00	0.76		5.17	5.04	1.13	0.65	6.26	1.87	2.64		14.52	9.42	0.84	0.55	2.49	2.29	2.69		174.29	11.59
White coating in fractures																								
SAN-034	0.95	0.73	5.59	2.52	0.16		1.32	3.61	2.37	0.60	8.45	7.53	1.65		25.44	13.96	2.36	0.25	2.20	7.00	4.20		211.89	17.03

4/11/94 Santaim Lemley

Additional samples prepared for trace element analysis by selective leach.

6 1g samples of rock powders SAN-022-WR1 and SAN-037-WR1 were placed in 50 ml centrifuge tubes + labelled as below:

	wt tube	wt tube+powder	wt powder
SAN-022-A	13.753g	14.774g	1.021g
SAN-022-B	13.708g	14.729g	1.021g
SAN-022-C	13.747g	14.773g	1.026g
SAN-022-D	13.945g	14.963g	1.018g
SAN-022-E	13.913g	14.939g	1.026g
SAN-022-F	13.779g	14.798g	1.019g
SAN-037-A	13.727g	14.751g	1.024g
SAN-037-B	13.773g	14.788g	1.015g
SAN-037-C	13.747g	14.766g	1.019g
SAN-037-D	13.643g	14.660g	1.017g
SAN-037-E	13.734g	14.761g	1.027g
SAN-037-F	13.843g	14.868g	1.025g

Leaching procedures on pp 121 + 125 were followed:

Sample labels

SAN-022	$MgCl_2$
SAN-037	$MgCl_2$
SAN-022	$NaOAc$
SAN-037	$NaOAc$
SAN-022	NH_2OH
SAN-037	NH_2OH

4/12/94 JP Preparation of whole rock powders:
Following samples are from the +10 level of Nopal and were taken across orebody boundary in a N/S traverse.

NOPI-372-WR1 is a powdered subsample of NOPI-372. Broken altered Tuff. Fe-oxide rich. Red to orange to yellow Fe-oxide throughout - cooty fractures as well as in matrix. Kaolinitic.
Wt = 29.0 g

NOPI-373-WR1 is a powdered subsample of NOPI-373. Broken altered Tuff. Fe-oxide rich - most Fe-oxide occurs as fracture coatings. Kaolinitic.
Wt = 32.8 g

NOPI-374-WR1 - Very altered Tuff - very kaolinitic. Rich in Fe-oxides - red + yellow mineral coatings surfaces of fractures. No visible minerals.
Wt = 34.0 g

NOPI-375-WR1 - Altered, broken limonite Tuff. Kaolinitic. Fe-oxides most common in fractures.
Wt = 30.5 g

NOPI-376-WRI - Altered, limonite, kaolinite tuff. Fe-oxides coat + fill fractures (orange-yellow in color) No visible U minerals.
Wt = 28.7 g

NOPI-379-WRI - Altered, kaolinite, limonite tuff. Yellow-orange Fe-oxides. No visible U minerals. Variably altered.
Wt = 32.8 g

NOPI-382-WRI - Limonite, hematite, kaolinized tuff. Dark red Fe-oxides coat some fractures. Matrix is Fe-oxide replaced.
Wt = 33.3 g

NOPI-385-WRI - Fe-oxide rich altered tuff, kaolinite. Fe oxides replaces some of matrix and fills fractures.
Wt = 27.8 g

NOPI-387-WRI - Altered kaolinite/tuff with Fe-oxides in fractures & coating fracture surfaces.
Wt = 29.7 g

NOPI-390-WRI - Altered, kaolinized tuff with Fe-oxides (hematite + goethite) in fractures & coating fracture surfaces.
Wt = 32.2 g

4/13/94 gp Sentani laundry.

6 1g Samples of rock powder SAN- -WRI and SAN- -WRI were placed in 50 ml centrifuge tubes & labelled as below:

	wt tube	wt+tube+powder	wt powder
SAN-029 A	13.766 g	14.781 g	1.015 g
SAN-029 B	13.700 g	14.722 g	1.022 g
SAN-029 C	13.664 g	14.684 g	1.020 g
SAN-029 D	13.690 g	14.709 g	1.019 g
SAN-029 E	13.811 g	14.832 g	1.021 g
SAN-029 F	13.812 g	14.838 g	1.026 g
SAN-045 A	13.969 g	14.979 g	1.010 g
SAN-045 B	13.607 g	14.631 g	1.024 g
SAN-045 C	13.678 g	14.696 g	1.018 g
SAN-045 D	13.744 g	14.758 g	1.014 g
SAN-045 E	13.717 g	14.728 g	1.011 g
SAN-045 F	13.588 g	14.612 g	1.024 g

Leaching procedure on pp 121 & 125 were followed:

Sample labels:

SAN-029	$MgCl_2$
SAN-045	$MgCl_2$
SAN-029	$NaOAc$
SAN-045	$NaOAc$
SAN-029	NH_2OH
SAN-045	NH_2OH

12/14/94 JJP Preparation of whole rock powders - Santorini

Portions of the following bulk rock samples were powdered and labelled as below.

	wt
SAN-024-WR1	105.3 g
SAN-031-WR1	49.0 g
SAN-039-WR1	52.5 g
SAN-047-WR1	54.4 g

~10 g of each powder was placed in a petri dish and dried in an oven at 100°C overnight

12/15/94 JJP Preparation of whole rock powders - Samples from continuation of E/W traverse on level 0.

NOPI-338-WR1 - Altered kaolinized tuff, hematite in matrix Fe-oxides coat surfaces of fractures.
Wt = 27.6 g

NOPI-339-WR1 - Altered, limonite tuff. Kaolinized. Yellow ocreye Fe-oxides coat fracture surfaces.
Wt = 27.4 g

NOPI-340-WR1 - Broken, Fe-oxide rich tuff. Matrix appears Fe-oxide rich. Fe oxides coat + fill fractures.
Wt = 37.0 g

NOPI-34-WR1 ~~Broken Tuff~~ very competent Not altered as previous samples Some Fe oxides line fractures.
Wt = 30.0 g Matrix densely kenatyte.

NOPI-342-WR1 - Mixture of tuff fragments in white & red vitrophyre. Right at contact. Fragments consist of altered kaolinized tuff with Fe-oxides
Wt = 24.6

NOPI-343-WR1 - Hematite + lemonite altered tuff fragments in mostly red purple vitrophyre.
Wt = 32.0 g

NOPI-344-WR1 - Clay altered vitrophyre. Mostly red purple with minor white material
Wt = 29.1 g

4/18/94 gp NOPI-345-WR1 - Clay altered vitrophyre
Both white + red purple material
Wt = 33.7 g

NOPI-346-WR1 - clay altered vitrophyre
Both White + Red purple clay altered material,
Wt = 24.0 g

NOPI-347-WR1 - Clay altered vitrophyre
Mostly white clay altered material with only minor red purple material
Wt = 20.9 g

NOPI-348-WR1 - Clay altered vitrophyre
Equal amounts of white + red purple clay altered material.
Wt = 25.9 g

NOPI-349-WR1 - Clay altered vitrophyre.
Red purple + White clay altered material
Wt = ~~25.9 g~~ 27.2 g

NOPI-350-WR1 - clay altered vitrophyre
Red purple clay altered material
Minor white clay altered material.
Wt = 32.0 g

NOPI-351-WR1 - clay altered vitrophyre
Both white + red purple clay altered material present. Some Fe-oxide staining on surfaces.
Wt = 28.6 g

NOPI-352-WR1 - clay altered vitrophyre
Red purple clay altered material.
Wt = 31.8 g

4/18/94 JP Sintanni leachj

6 1g samples of SAN-024-WR1 and SAN-039-WR1 were placed in 50 ml centrifuge tubes & labeled as below:

	Wt tube	Wt tube + powder	Wt powder
SAN-024-A	13.946 g	14.967 g	1.021 g
SAN-024-B	13.695 g	14.712 g	1.017 g
SAN-024-C	13.722 g	14.750 g	1.028 g
SAN-024-D	13.804 g	14.813 g	1.009 g
SAN-024-E	13.928 g	14.953 g	1.025 g
SAN-024-F	13.724 g	14.734 g	1.010 g
SAN-039-A	13.584 g	14.606 g	1.022 g
SAN-039-B	13.834 g	14.851 g	1.017 g
SAN-039-C	13.749 g	14.761 g	1.012 g
SAN-039-D	13.740 g	14.752 g	1.012 g
SAN-039-E	13.805 g	14.822 g	1.017 g
SAN-039-F	14.033 g	15.061 g	1.028 g

Leaching procedure on page 121 and 125 were followed:

Sample labels:

SAN-024	$MgCl_2$
SAN-039	$MgCl_2$
SAN-024	NaOAc
SAN-039	NaOAc
SAN-024	NH_2OH
SAN-039	NH_2OH

4/18/94 JP Prepared powders for gamma analysis Samples consist of aliquots of whole rock powders (WR1) prepared previously

	wt vial	wt vial + powder	wt sample
NOPI-338-~~WR~~ GAM1	2.077 g	5.842 g	3.765 g
NOPI-339-GAM1	2.067 g	5.675 g	3.608 g
NOPI-340-GAM1	2.072 g	6.038 g	3.966 g
NOPI-341-GAM1	2.063 g	5.877 g	3.814 g
NOPI-342-GAM1	2.071 g	5.954 g	3.883 g
NOPI-343-GAM1	2.067 g	6.103 g	4.036 g
NOPI-344-GAM1	2.068 g	6.136 g	4.068 g
NOPI-345-GAM1	2.072 g	6.162 g	4.090 g
NOPI-346-GAM1	2.052 g	5.808 g	3.756 g
NOPI-347-GAM1	2.058 g	5.867 g	3.809 g
NOPI-348-GAM1	2.059 g	5.851 g	3.792 g
NOPI-349-GAM1	2.060 g	5.895 g	3.835 g
NOPI-350-GAM1	2.073 g	5.936 g	3.863 g
NOPI-351-GAM1	2.072 g	5.931 g	3.859 g
NOPI-352-GAM1	2.077 g	5.774 g	3.697 g

4/19/94 JF Preparation of whole rock powders - Santorini

Portions of the following bulk rock samples were powdered and labeled as below:

	Wt
SAN-021-WR1	65.9 g
SAN-028-WR1	55.2 g
SAN-036-WR1	53.8 g
SAN-044-WR1	59.8 g

~10 g of each powder was placed in a petri dish + dried at 100°C in an oven overnight

4/20/94 JF Santorini leaching

6 1g samples of SAN-031-WR1 and SAN-047-WR1 were placed in 50 ml centrifuge tubes + labeled as below:

	wt tube	wt tube + powder	wt powder
SAN-031-A	13.749 g	14.782 g	1.033 g
SAN-031-B	13.739 g	14.751 g	1.012 g
SAN-031-C	13.764 g	14.793 g	1.029 g
SAN-031-D	13.702 g	14.722 g	1.020 g
SAN-031-E	13.733 g	14.761 g	1.028 g
SAN-031-F	13.706 g	14.739 g	1.033 g
SAN-047-A	13.716 g	14.748 g	1.032 g
SAN-047-B	13.739 g	14.764 g	1.025 g
SAN-047-C	13.722 g	14.739 g	1.017 g
SAN-047-D	13.779 g	14.792 g	1.013 g
SAN-047-E	13.734 g	14.765 g	1.031 g
SAN-047-F	13.742 g	14.760 g	1.018 g

Leach procedure on p121 + 125 was followed:

Sample Labels:

SAN-031	$MgCl_2$
SAN-047	$MgCl_2$
SAN-031	NaOAc
SAN-047	NaOAc
SAN-031	NH_2OH
SAN-047	NH_2OH

4/25/94 Santorini Leahy:

6 lg samples of SAN-021-WR1 and SAN-036-WR1 were placed in 50 ml PP centrifuge tubes & labeled as follows:

	wt tube	wt tube + powder	wt powder
SAN-021-A	13.855 g	14.865 g	1.010 g
SAN-021-B	13.730 g	14.740 g	1.010 g
SAN-021-C	13.726 g	14.745 g	1.019 g
SAN-021-D	13.718 g	14.739 g	1.018 g
SAN-021-E	13.780 g	14.799 g	1.019 g
SAN-021-F	13.666 g	14692 g	1.02 g
SAN-036-A	13.905 g	14.929 g	1.024 g
SAN-036-B	13.908 g	14.923 g	1.015 g
SAN-036-C	13.621 g	14.643 g	1.022 g
SAN-036-D	13.919 g	14.927 g	1.008 g
SAN-036-E	13.877 g	14.878 g	1.001 g
SAN-036-F	13.882 g	14.899 g	1.017 g

Leahy procedure on p121 of p125 was followed:

Sample labels:

SAN-021 $MgCl_2$
SAN-036 $MgCl_2$
SAN-021 NaOAc
SAN-036 NaOAc
SAN-021 NH_2OH
SAN-036 NH_2OH

4/26/94 Preparation of whole rock powders - Santorini

Portions of the following bulk rock samples were powdered & labeled as below

	wt
SAN-025-WR1	76.47 g
SAN-032-WR1	53.50 g
SAN-040-WR1	58.22 g
SAN-048-WR1	54.68 g

~10 g of each powder was placed in a petri dish & dried at 100°C.

4/26/94 AA analysis of Santorini leachates

Samples

SAN-022	SAN024
SAN-029	SAN031
SAN-037	SAN-039
SAN-045	SAN-047

Procedures + dilution factors are same as on p146-148.

Data + calculations kept in 3 ring binder "Trace Metal Leach Data, Santorini Cruise".

Santorini Leachates

SAMPLE NO.	MgCl2 exchangeable Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn	Carbonate fraction Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn	Fe-Mn oxides Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn
Profiles																								
(Hole II)																								
SAN-022	0.68	0.47	4.48	1.06	0.37		2.68	11.67	1.27	0.65	5.86	1.94	1.38		0.00	18.48	1.43	0.19	8.91	0.63	5.92		61.80	125.71
SAN-029	1.02	0.66	4.19	2.88	0.27		2.99	5.62	1.60	0.26	2.89	1.76	1.55		0.00	9.84	1.07	0.13	1.79	0.41	2.70		106.10	25.04
SAN-037	0.72	0.18	3.22	1.98	0.34		7.14	4.19	1.73	0.00	2.52	1.74	1.83		6.34	5.81	0.65	0.00	1.17	0.45	1.28		59.59	24.31
SAN-045	0.66	0.20	2.58	0.83	0.05		5.15	2.63	1.73	0.00	2.98	1.98	2.60		15.55	7.68	0.63	0.02	1.28	0.40	2.12		67.04	22.83
(Hole III)																								
SAN-023	1.16	1.01	2.75	3.91	0.71		0.84	9.64	1.88	0.85	3.22	5.05	0.79		4.80	20.16	2.47	0.51	5.22	4.12	5.30		39.06	117.94
SAN-030	0.84	0.85	4.13	2.11	0.58		1.96	2.48	1.87	0.82	4.04	6.14	1.28		0.90	10.43	1.11	0.04	1.85	7.53	2.20		101.68	24.50
SAN-038	1.01	0.73	5.12	4.01	0.32		1.15	2.34	1.67	0.54	3.82	4.15	1.94		0.00	10.98	0.88	0.13	1.32	7.52	1.73		99.14	16.17
SAN-046	0.73	0.58	5.55	3.47	0.28		1.13	3.55	1.50	0.35	3.27	3.55	2.15		2.97	9.08	0.57	0.65	1.19	5.88	1.54		105.60	17.74
(Hole IV)																								
SAN-024	0.70	0.27	3.63	4.36	0.09		2.95	20.49	1.76	0.39	6.55	2.38	1.07		2.03	23.67	1.77	0.31	9.79	2.22	6.41		46.50	83.42
SAN-031	0.54	0.26	2.52	1.38	0.16		0.70	2.88	2.52	0.21	6.67	1.86	0.77		4.90	11.44	1.89	0.43	3.22	1.54	4.03		55.38	36.80
SAN-039	0.17	0.20	2.92	2.77	0.15		1.78	1.59	2.14	0.12	2.46	2.33	1.66		11.30	8.81	0.42	0.69	0.53	0.93	1.67		98.92	12.83
SAN-047	0.51	0.20	3.00	2.38	0.05		2.12	2.96	1.83	0.24	0.81	0.92	1.75		6.25	6.25	0.25	0.70	0.53	1.44	1.56		82.03	6.80
(Hole VI)																								
SAN-027	0.79	0.70	2.91	3.35	0.32		3.75	3.71	1.45	1.24	2.84	2.33	0.88		2.31	15.13	3.12	0.36	6.27	2.46	5.02		39.09	101.79
SAN-033	0.62	0.50	3.80	3.57	0.52		5.88	1.26	1.83	0.57	2.68	3.10	2.31		0.18	10.79	1.39	0.00	1.08	2.04	3.04		120.36	24.31
SAN-041	0.44	0.41	3.25	3.04	0.39		5.09	2.19	1.45	0.21	2.22	3.21	1.71		0.00	8.54	0.63	0.00	0.95	2.65	1.35		100.87	10.52
SAN-049	0.44	0.20	2.88	2.88	0.67		4.29	1.23	1.95	0.66	2.70	3.13	1.74		0.53	8.49	0.58	0.00	0.95	1.69	1.46		99.15	11.64
Base Chemistry																								
SAN-053	0.86	0.67	8.62	2.00	0.76		5.17	5.04	1.13	0.65	6.26	1.87	2.64		14.52	9.42	0.84	0.55	2.49	2.29	2.69		174.29	11.59
White coating in fractures																								
SAN-034	0.95	0.73	5.59	2.52	0.16		1.32	3.61	2.37	0.60	8.45	7.53	1.65		25.44	13.96	2.36	0.25	2.20	7.00	4.20		211.89	17.03

4/27/94 Santorini Leachs

6 1g samples of NOPI-028-WR1 and NOPI-044-WR1 were placed in 50ml PP centrifuge tubes + labeled as below:

	wt tube	wt tube + powder	wt powder
SAN-028-A	13.611g	14.641g	1.030g
SAN-028-B	13.806g	14.816g	1.010g
SAN-028-C	13.575g	14.601g	1.026g
SAN-028-D	13.792g	14.817g	1.025g
SAN-028-E	13.698g	14.718g	1.020g
SAN-028-F	13.929g	14.958g	1.029g
SAN-044-A	14.132g	15.142g	1.010g
SAN-044-B	13.723g	14.741g	1.018g
SAN-044-C	13.821g	14.824g	1.003g
SAN-044-D	13.725g	14.744g	1.019g
SAN-044-E	13.726g	14.748g	1.022g
SAN-044-F	13.876g	14.888g	1.012g

Leach procedure on p121 of 125 was conducted.

Sample labels:

SAN-028	$MgCl_2$
SAN-044	$MgCl_2$
SAN-028	NaOAc
SAN-044	NaOAc
SAN-028	NH_2OH
SAN-044	NH_2OH

4/28/94 gp Alpha spectrometry measurements on powdered whole rock samples collected from Nopal I will be measured using method of Gascoyne and Hasogue:

"A Rapid Method of Extraction of U and Th from granite for Alpha Spectrometry." (see p 23)

Analytical data will be recorded on the data sheet shown in the opposite page.

Results and data reduction calculations will be kept in a 3-ring binder entitled "Alpha Spectrometry Analyses Nopal I, Level +10".

4/28/94 gp Samples

NOPI-376-WR1
NOPI-379-WR1
NOPI-382-WR1
NOPI-385-WR1

were processed and measured by alpha spectrometry.

U/Th Fusion (Nopal whole rock samples)

Sample I. D. # _____

Date _____

Fusion: Mix about 1 g of sample powder with about 3 g of "SPEX" $LiBO_2$ and add a measured aliquot (0.1 to 1.0 ml) of ^{232}U-^{228}Th spike solution in dulite HNO_3.

Weights: SPEX $LiBO_2$ (Lot # _____) _____ g

Sample powder _____ g

^{232}U-^{228}Th spike # _____ Reference Date _____

Reference Activity _____ pCi/g Spike Weight _____ g

Dry mixture under heat lamp for about 30 min, remix, and pack in graphite crucible.
Place crucible in muffle furnace at 950°C for 30 mins, then pour contents immediately into 200 ml of 1 M HNO_3 with rapid stirring. The $LiBO_2$-silicate glass formed on cooling should dissolve in about 20 mins. Filter solution to remove graphite particles and split sample into two parts (100 ml is saved in a PP bottle and the other 100 ml is analyzed for U and Th isotopes.

Extraction: To the aqueous solution, 37.5 g of $Al(NO_3)_3 \cdot 9H_2O$ is added as a salting agent, and U and Th are extracted using 25 ml of 10% tributylphosphate (TBP) solution in amyl acetate. The mixture is shaken for 30 min. to extract both U and Th into the organic phase (pour into separatory funnel, drain inorganic to waste, and save organic).

Weight: $Al(NO_3)_3 \cdot 9H_2O$ (Lot # _____) _____ g

10% TBP/amyl acetate (Lot #s _____/_____) _____ ml

U and Th are then back extracted using 4 X 25 ml of 1 M H_2SO_4 (extract, pour into separatory funnel, and save H_2SO_4).
The sulphuric acid solution is gently boiled to dryness and then heated more strongly to drive off SO_3. The dried residue is dissolved immediately in about 20-30 ml of 9 N HCl.

Column Separation:

Preparation: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # _____)

Prewash 4 cm X 1 cm column of resin with 45 ml 0.1 N HCl, then condition with 60 ml 9 N HCl.

Elution:

Load aqueous sample on column and allow to drain.
Elute Th fraction with 45-60 ml of 9 N HCl. Separation Date _____
Elute U fraction with 45-60 ml of 0.1 N HCl
Evaporate both eluates to dryness.

Plating:

Dry residues are each dissolved in < 5 ml 0.1 N HNO_3 and separated from daughter nuclides and trace elements carried over in TBP, by extraction into 0.4 M TTA in benzene, at pH 1 for Th and pH 3.5 for U.
~~Benzene is removed by gently boiling, and~~ the remaining solution volume is transferred to a heated stainless steel disc for evaporation to dryness. Discs are briefly flamed to red heat to remove any remaining organic and then counted.

gp 4/23/94

Counting Date _____

4/29/94 TAMU microprobe results:

Thin sections of Fe-oxide cantaing fractures from Bopal I (see p 132-134) were analyzed by Ray Guillemette at Texas A+M Univ. and results were transferred over computer network.

Results consisted of microprobe spot analyses shows elemental composition of phases (minerals) and images (backscattered electron images).

All data is kept in a 3 ring binder entitled "TAMU Microprobe Data, Fe-oxide Fracture, Bopal I, level +10, 13.5 M North".

5/2/94 gp Santani Leachy

6 1g samples of SAN-025-WRI and SAN-040-WRI were placed in 50 ml centrifuge tubes + labeled as below:

	wt tube	wt tube + powder	wt powder
SAN-025-A	13.980 g	15.003 g	1.023 g
SAN-025-B	13.724 g	14.751 g	1.027 g
SAN-025-C	13.725 g	14.742 g	1.017 g
SAN-025-D	13.707 g	14.742 g	1.035 g
SAN-025-E	13.783 g	14.812 g	1.029 g
SAN-025-F	13.732 g	14.752 g	1.020 g
SAN-040-A	13.721 g	14.739 g	1.018 g
SAN-040-B	13.650 g	14.665 g	1.015 g
SAN-040-C	13.722 g	14.731 g	1.009 g
SAN-040-D	13.911 g	14.926 g	1.015 g
SAN-040E	13.832 g	14.866 g	1.034 g
SAN-040-F	13.707 g	14.717 g	1.010 g

leach procedure on p121 and 125 was followed.

Single labels:

SAN-025	$MgCl_2$
SAN-040	$MgCl_2$
SAN-025	NaOAc
SAN-040	NaOAc
SAN-025	NH_2OH
SAN-040	NH_2OH

5/3/94 gp Preparation of whole rock powders
Scintomi

Portions of the following bulk rock samples were powdered and placed in labeled plastic vials.

	wt
SAN-026-WR1	35.26 g
SAN-035-WR1	34.9 g
SAN-042-WR1	37.2 g
SAN-043-WR1	31.4 g
SAN-050-WR1	30.0 g
SAN-051-WR1	28.9 g
SAN-052-WR1	32.7 g

~10 g of each sample was placed in a petri dish and ~~put~~ dried overnight at 100°C.

5/4/94 gp Scintomi Lemley

6 1g samples of SAN-032-WR1 and SAN-048-WR1 were placed in 50 ml centrifuge tubes and labeled as below:

	wt tube	wt tube + powder	wt powder
SAN-032-A	13.743 g	14.757 g	1.014 g
SAN-032-B	13.720 g	14.732 g	1.012 g
SAN-032-C	13.701 g	14.720 g	1.019 g
SAN-032-D	13.734 g	14.756 g	1.022 g
SAN-032-E	13.682 g	14.709 g	1.025 g
SAN-032-F	13.810 g	14.823 g	1.013 g
SAN-048-A	13.734 g	14.765 g	1.031 g
SAN-048-B	13.701 g	14.715 g	1.014 g
SAN-048-C	13.810 g	14.838 g	1.028 g
SAN-048-D	13.812 g	14.831 g	1.019 g
SAN-048-E	13.740 g	14.766 g	1.026 g
SAN-048-F	13.808 g	14.824 g	1.016 g

Leach procedure on p 121 and 125 was conducted:

Sample / Labels:

SAN-032	$MgCl_2$
SAN-048	$MgCl_2$
SAN-032	$NaOAc$
SAN-048	$NaOAc$
SAN-032	NH_2OH
SAN-048	NH_2OH

5/4/94 JP Preparation of whole rock powders - Samples from continuation of NW/SE traverse on level 0. of Nopal I

NOPI-354-WR1 - broken, altered, Fe-oxide rich tuff. Kaolinized. Fe-oxides coat fracture surfaces. No visible U minerals, limonite.
Wt = 50.3 g

NOPI-355-WR1 - Fragments of broken altered tuff in clay altered tuff. Fe-oxides coat fracture surfaces of tuff fragments.
Wt = 39.7 g

NOPI-356-WR1 - Clay altered tuff. Fe-oxides common. Moderately consolidated.
Wt = 37.7 g

NOPI-357-WR1 - Clay altered tuff or clay altered vitrophyre. Mostly tan brown in color. Some Fe-oxides present.
Wt = 35.5 g

NOPI-358-WR1 - Clay altered vitrophyre with material from fracture that appears to be calcitized (white very competent rock). Altered vitrophyre is mostly red purple in color.
Wt = 34.3 g

NOPI-359-WR1 - Clay altered vitrophyre. Red/purple in color.
Wt = 32.7 g

NOPI-360-WR1 - Clay altered vitrophyre Red purple in color.
Wt = 32.8 g

NOPI-361-WR1 - Clay altered vitrophyre Red purple in color.
Wt = 30.3 g

5/6/94 gp Preparation of powders for gamma analysis. Samples consist of portions of whole rock powders prepared previously.

	wt vial	wt vial + powder	wt powder
NOPI-354-GAM1	2.086g	6.269g	4.183g
NOPI-355-GAM1	2.086g	6.146g	4.060g
NOPI-356-GAM1	2.108g	6.042g	3.934g
NOPI-357-GAM1	2.087g	5.978g	3.891g
NOPI-358-GAM1	2.092g	6.318g	4.226g
NOPI-359-GAM1	2.107g	6.062g	3.955g
NOPI-360-GAM1	2.098g	6.006g	3.908g
NOPI-361-GAM1	2.106g	5.997g	3.891g

5/6/94 gp Preparation of whole rock powders - samples for +10 level NOPAL I. Traverse across orebody bounding to N.

NOPI-377-WR1 - Fe-oxide bearing altered tuff. Kaolinized Fe-oxide coat + fill fracture. Variably altered
Wt= 35.6g

NOPI-378-WR1 - Fe-oxide bearing altered Kaolinized Tuff. Fe-oxide coat + fill fracture. Variably altered
Wt= 38.7g

NOPI-380-WR1 - Altered tuff, kaolinized contains Fe-oxides in coatings + fracture fill
Wt= 32.2g

5/9/94 gp NOPI-381-WR1 - Altered Fe-oxide bearing ~~Tuff~~ Kaolinized Fe-oxide fill and coat fractures
Wt= 41.3g

NOPI-383-WR1 - Altered Fe-oxide bearing ~~Tuff~~. Fe-oxides coat and fill fractures. Kaolinized.
Wt= 32.7

NOPI-384-WR1 - Altered, kaolinized, Fe-oxide bearing tuff. Fe-oxides fill & coat fractures.
Wt = 33.5 g

NOPI-386-WR1 - Altered, kaolinized Fe-oxide bearing tuff. Fe-oxides fill & coat fractures.
Wt = 35.3 g

NOPI-388-WR1 - Altered kaolinized tuff. Fe-oxides coat & fill fractures. Fe-oxides not abundant.
Wt = 35.1 g

NOPI-389-WR1 - Altered, kaolinized, very Fe-oxide rich tuff. Fe oxides occur as fracture fillings & coatings.
Wt = 33.7 g

NOPI-391-WR1 Altered, kaolinized, Fe-oxide bearing tuff. Fe-oxides occur as fracture coatings.
Wt = 34.2 g

5/9/94 JJP Santani leaching

6 1g samples of SAN-035-WR1 and SAN-051-WR1 were placed in 50 ml centrifuge tubes.

	wt tube	wt tube + powder	wt powder
SAN-035-A	13.689 g	14.720 g	1.031
SAN-035-B	13.705 g	14.721 g	1.016
SAN-035-C	13.722 g	14.745 g	1.023
SAN-035-D	13.635 g	14.656 g	1.020
SAN-035-E	13.702 g	14.716 g	1.014
SAN-035-F	13.728 g	14.744 g	1.016
SAN-051-A	13.753 g	14.771 g	1.018
SAN-051-B	13.748 g	14.772 g	1.024
SAN-051-C	13.773 g	14.793 g	1.020
SAN-051-D	13.901 g	14.918 g	1.009
SAN-051-E	13.730 g	14.739 g	1.009
SAN-051-F	13.684 g	14.706 g	1.022

Leaching procedures on p 121 and 125 were conducted:

Sample labels:

SAN-035	$MgCl_2$
SAN-051	$MgCl_2$
SAN-035	NaOAc
SAN-051	NaOAc
SAN-035	NH_2OH
SAN-051	NH_2OH

5/11/94 JP Santorini leachig.

6 1g samples of SAN-026-WR1 and SAN-043-WR1 were placed in 50 ml centrifuge tubes.

	wt tube	wt tube + powder	wt powder
SAN-026-A	13.685g	14.699g	1.014
SAN-026-B	13.901g	14.925g	1.024
SAN-026-C	13.651g	14.669g	1.018
SAN-026-D	14.059g	15.078g	1.019
SAN-026-E	13.706g	14.732g	1.026
SAN-026-F	13.742g	14.770g	1.028
SAN-043-A	13.794g	14.809g	1.015
SAN-043B	13.780g	14.800g	1.020
SAN-043-C	13.610g	14.624g	1.014
SAN-043-D	13.891g	14.912g	1.021
SAN-043-E	13.933g	14.963g	1.030
SAN043-F	13.719g	14.750g	1.031

Leachig procedures p121+125 were conducted.

Sample labels

SAN-026	$MgCl_2$
SAN-043	$MgCl_2$
SAN-026	$NaOAc$
SAN-043	$NaOAc$
SAN-026	NH_2OH
SAN-043	NH_2OH

5/11/94 AA analysis of Santorini leachate.

Samples

SAN-025
SAN-032
SAN-040
SAN-048

SAN-021
SAN-028
SAN-036
SAN-044

Procedure + dilution factor are same as on p146-148

Data + calculate kept in 3 ring binders "Metal Leachig Data, Santorini, Greece"

7/16/94 JJP Santorini Leachs

6 1g samples of SAN-042-WR1 and SAN-050-WR1 were placed in 50 ml centrifuge tubes

	wt tube	wt tube + powder	wt powder
SAN-042-A	13.784g	14.796g	1.012g
SAN-042-B	13.810g	14.824g	1.014g
SAN-042-C	13.704g	14.710g	1.006g
SAN-042-D	13.995g	15.012g	1.017g
SAN-042-E	13.824g	14.839g	1.015g
SAN-042-F	13.963g	14.970g	1.007g
SAN-050-A	13.616g	14.630g	1.014g
SAN-050-B	13.706g	14.732g	1.026g
SAN-050-C	14.098g	15.093g	0.995g
SAN-050-D	13.826g	14.853g	1.027g
SAN-050-E	13.792g	14.818g	1.026g
SAN-050-F	13.717g	14.728g	1.011g

Leachs procedures on p121 + 125 were ~~extended~~

Sample labels:

SAN-042	$MgCl_2$
SAN-050	$MgCl_2$
SAN-042	NaOAc
SAN-050	NaOAc
SAN-042	NH_2OH
SAN-050	NH_2OH

5/17/94 JJP AA analysis of Santorini leachates

Samples
SAN-026
SAN-035
SAN-043
SAN-051

Procedures + dilution factors are same as on p146-148

Data + calculations kept in 3 ring binders "Metal Leach Data, Santorini, Greece"

5/23/94 Santorini Leachy

6 1g samples of SAN-052-WR1 were placed in 50 ml centrifuge tubes

	wt tube	wt tube + powder	wt powder
SAN-052-A	13.760g	14.790g	1.030g
SAN-052-B	13.782g	14.808g	1.026g
SAN-053-C	13.711g	14.727g	1.016g
SAN-052-D	13.648g	14.668g	1.020g
SAN-052-E	13.671g	14.687g	1.016g
SAN-052-F	13.923g	14.933g	1.010g

Leachy procedure on p 121+125 were conducted.

Sample labels:

SAN-052 $MgCl_2$
SAN-052 NaOAc
SAN-052 NH_2OH

5/23/94 Alpha counts of Nopal bulk rock samples. (p 174).

Samples

NOPI-372-WR1
NOPI-375-WR1
NOPI-387-WR1
NOPI-390-WR1

were processed & measured by alpha spectrometry.

5/24/94 gjp

XRD analysis of Santorini rock samples. These analyses were performed to determine the mineralogy of white-colored fracture fill material in hole 7 in Room Delta 3 at the Santorini caldera.

White material was handpicked from samples, powdered, and analyzed by XRD in Div 06.

Samples

SAN-051
SAN-042
SAN-034

were picked for analysis.

Sample XRD powders were labeled as follows:

SAN-051-XRD2
SAN-042-XRD2
SAN-034-XRD2

Results were placed in 3 ring binder entitled "XRD Analyses, Santorini Greece".

5/26/94 gjp

Preparation of samples for gamma analysis. Samples consist of portions of whole rock powders prepared previously.

	wt vial	wt vial + powder	wt powder
NOPI-372-GAM1	2.069 g	5.792 g	3.723 g
NOPI-373-GAM1	2.067 g	6.022 g	3.955 g
NOPI-374-GAM1	2.069 g	5.493 g	3.424 g
NOPI-375-GAM1	2.057 g	5.858 g	3.801 g
NOPI-376-GAM1	2.070 g	5.777 g	3.707 g
NOPI-377-GAM1	2.078 g	5.828 g	3.750 g
NOPI-378-GAM1	2.061 g	5.811 g	3.750 g
NOPI-379-GAM1	2.081 g	5.905 g	3.824 g
NOPI-380-GAM1	2.067 g	5.618 g	3.551 g
NOPI-381-GAM1	2.085 g	6.122 g	4.037 g
NOPI-382-GAM1	2.074 g	6.081 g	4.007 g
NOPI-383-GAM1	2.070 g	5.957 g	3.887 g
NOPI-384-GAM1	2.078 g	5.807 g	3.729 g
NOPI-385-GAM1	2.056 g	5.808 g	3.752 g
NOPI-386-GAM1	2.081 g	5.657 g	3.576 g
NOPI-387-GAM1	2.059 g	5.866 g	3.807 g

NOPI-388-GAM1	2.059g	5.710g	3.651g
NOPI-389-GAM1	2.066g	5.930g	3.864g
NOPI-390-GAM1	2.082g	5.935g	3.853g
NOPI-391-GAM1	2.069g	5.791g	3.722g

5/27/94 JP AA analysis of Santorini leachates:

Samples:
SAN-042
SAN-050
SAN-052

Procedure & dilution factors are same as on p146-148

Data & calculations kept in 3 ring binder "Metal Leach Data, Santorini, Greece"

5/31/94 gp

Santorini Leaching Results

Santorini Leaching Results

SAMPLE NO.	MgCl2 exchangeable								Carbonate fraction								Fe-Mn oxides							
	Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn	Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn	Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn
Profiles																								
(Hole I)																								
SAN-021	1.05	0.94	4.87	5.91	0.57		5.50	5.67	1.49	1.50	5.30	4.71	1.36		0.00	13.55	2.12	0.00	7.15	5.52	4.13		62.09	83.32
SAN-028	1.24	0.83	4.25	5.41	0.55		1.13	4.25	2.99	0.70	4.84	4.75	1.17		0.00	15.82	1.86	0.00	2.45	4.52	3.27		127.45	34.45
SAN-036	1.11	0.83	6.19	6.47	0.59		1.52	3.75	1.83	0.84	4.79	3.88	1.76		8.43	8.32	0.70	0.00	1.91	4.49	1.62		121.81	13.43
SAN-044	0.74	0.97	4.76	4.94	0.52		3.63	4.53	1.53	0.82	5.03	4.89	1.76		9.86	7.28	0.65	0.15	1.67	4.67	1.51		74.87	10.55
(Hole II)																								
SAN-022	0.68	0.47	4.48	1.06	0.37		2.68	11.67	1.27	0.65	5.86	1.94	1.38		0.00	18.48	1.43	0.19	8.91	0.63	5.92		61.80	125.71
SAN-029	1.02	0.66	4.19	2.88	0.27		2.99	5.62	1.60	0.26	2.89	1.76	1.55		0.00	9.84	1.07	0.13	1.79	0.41	2.70		106.10	25.04
SAN-037	0.72	0.18	3.22	1.98	0.34		7.14	4.19	1.73	0.00	2.52	1.74	1.83		6.34	5.81	0.65	0.00	1.17	0.45	1.28		59.59	24.31
SAN-045	0.66	0.20	2.58	0.83	0.05		5.15	2.63	1.73	0.00	2.98	1.98	2.60		15.55	7.68	0.63	0.02	1.28	0.40	2.12		67.04	22.83
(Hole III)																								
SAN-023	1.16	1.01	2.75	3.91	0.71		0.84	9.64	1.88	0.85	3.22	5.05	0.79		4.80	20.16	2.47	0.51	5.22	4.12	5.30		39.06	117.94
SAN-030	0.84	0.85	4.13	2.11	0.58		1.96	2.48	1.87	0.82	4.04	6.14	1.28		0.90	10.43	1.11	0.04	1.85	7.53	2.20		101.68	24.50
SAN-038	1.01	0.73	5.12	4.01	0.32		1.15	2.34	1.67	0.54	3.82	4.15	1.94		0.00	10.98	0.88	0.13	1.32	7.52	1.73		99.14	16.17
SAN-046	0.73	0.58	5.55	3.47	0.28		1.13	3.55	1.50	0.35	3.27	3.55	2.15		2.97	9.08	0.57	0.65	1.19	5.88	1.54		105.60	17.74
(Hole IV)																								
SAN-024	0.70	0.27	3.63	4.36	0.09		2.95	20.49	1.76	0.39	6.55	2.38	1.07		2.03	23.67	1.77	0.31	9.79	2.22	6.41		46.50	83.42
SAN-031	0.54	0.26	2.52	1.38	0.16		0.70	2.88	2.52	0.21	6.67	1.86	0.77		4.90	11.44	1.89	0.43	3.22	1.54	4.03		55.38	36.80
SAN-039	0.17	0.20	2.92	2.77	0.15		1.78	1.59	2.14	0.12	2.46	2.33	1.66		11.30	8.81	0.42	0.69	0.53	0.93	1.67		98.92	12.83
SAN-047	0.51	0.20	3.00	2.38	0.05		2.12	2.96	1.83	0.24	0.81	0.92	1.75		6.25	6.25	0.25	0.70	0.53	1.44	1.56		82.03	6.80
(Hole V)																								
SAN-025	1.06	0.66	6.11	4.74	0.55		1.51	17.69	1.26	0.62	8.91	3.56	1.43		5.11	19.05	1.52	0.06	10.13	2.75	6.69		54.38	75.16
SAN-032	0.92	0.68	4.75	3.86	0.43		2.02	3.90	1.24	0.24	5.11	3.56	1.72		7.24	8.68	0.71	0.00	0.85	2.70	1.69		88.63	7.10
SAN-040	0.39	0.57	4.96	5.06	0.41		2.68	2.29	1.24	0.82	3.29	2.35	1.84		12.45	5.66	0.59	0.13	0.55	2.80	1.22		92.84	5.35
SAN-048	0.79	1.02	5.31	3.57	0.43		1.01	4.00	0.69	0.72	3.26	4.12	1.73		23.58	6.70	0.41	0.02	0.63	2.36	1.07		87.89	6.20
(Hole VI)																								
SAN-027	0.79	0.70	2.91	3.35	0.32		3.75	3.71	1.45	1.24	2.84	2.33	0.88		2.31	15.13	3.12	0.36	6.27	2.46	5.02		39.09	101.79
SAN-033	0.62	0.50	3.80	3.57	0.52		5.88	1.26	1.83	0.57	2.66	3.10	2.31		0.18	10.79	1.39	0.00	1.08	2.04	3.04		120.36	24.31
SAN-041	0.44	0.41	3.25	3.04	0.39		5.09	2.19	1.45	0.21	2.22	3.21	1.71		0.00	8.54	0.63	0.00	0.95	2.65	1.35		100.87	10.52
SAN-049	0.44	0.20	2.88	2.88	0.67		4.29	1.23	1.95	0.66	2.70	3.13	1.74		0.53	8.49	0.58	0.00	0.95	1.69	1.46		99.15	11.64
(Hole VII) Bedrock																								
SAN-035	1.51	1.18	7.54	7.88	1.22		4.58	3.11	1.86	1.49	8.86	7.30	6.44		39.22	9.87	0.92	0.36	3.39	5.97	5.73		169.16	11.27
SAN-043	1.51	0.91	8.04	6.71	1.00		4.28	4.20	1.40	1.19	7.72	7.40	2.62		33.32	6.07	0.57	0.25	2.72	7.53	1.95		88.79	8.88
SAN-052	1.35	0.84	6.76	4.47	0.82		1.32	2.50	2.06	1.02	6.50	5.13	1.95		21.90	7.29	1.57	0.04	2.12	4.05	1.97		158.25	5.76
Bedrock with fractures																								
SAN-026	1.73	1.12	6.85	5.59	0.96		0.34	1.11	2.04	1.25	7.52	7.55	3.55		7.24	11.82	1.17	0.53	2.80	7.13	5.31		127.50	16.36
SAN-034	0.95	0.73	5.59	2.52	0.16		1.32	3.61	2.37	0.60	8.45	7.53	1.65		25.44	13.96	2.36	0.25	2.20	7.00	4.20		211.89	17.03
SAN-042	1.39	0.84	6.23	4.72	0.79		3.51	4.01	2.47	1.10	6.41	5.76	1.91		12.13	8.69	1.82	0.08	4.87	4.03	3.78		179.35	13.00
SAN-050	1.27	0.81	6.50	5.25	0.78		2.48	4.63	2.36	1.17	4.89	5.23	1.98		24.62	5.96	0.94	0.04	1.31	4.47	1.55		95.53	6.81
SAN-051	1.43	1.14	5.33	7.38	1.35		1.74	4.67	2.66	1.62	5.20	6.80	2.12		6.62	8.24	2.90	0.40	3.23	6.97	4.99		106.90	25.15
Base Chemistry																								
SAN-053	0.86	0.67	8.62	2.00	0.76		5.17	5.04	1.13	0.65	6.26	1.87	2.64		14.52	9.42	0.84	0.55	2.49	2.29	2.69		174.29	11.59

6/6/94 Alpha county of Nupal bulk rock sampler (p174)

Samples
NOPI-376-WR1
NOPI-379-WR1
NOPI-382-WR1
NOPI-385-WR1

were processed & measured by alpha spectrometry. This is a rerun of samples prepared on 4/28/94 (p174).

4/6/94 Preparation of powders From a fracture on fault on Nopal +10 level that trends to North across orebody boundary. Fracture material collected was handpicked & powdered for analysis. Samples were placed in plastic vials + labeled as below:

NOPI-399-WR1 - Goethite (orange) and hematite; minor jarosite. No U minerals. Numerous altered tuff fragments
Wt= 2.9 g

NOPI-400-WR1 - Jarosite, goethite, and black colored Fe-oxide (hematite) in kaolinized tuff. Wt= 1.1 g

NOPI-401-WR1 - Mostly orange colored goethite, minor hematite (red-black metallic) Altered tuff not hematized
Wt= 10.6 g

NOPI-405-WR1 - Mostly orange goethite, some black Fe-oxide (?) Minor unidentified crystals in small vugs. Tuff fragments in fracture.
Wt= 14.1 g

NOPI-402-WR1 - Goethite - orange colored material. Some black Fe-oxide. Variably altered tuff fragments.
Wt= 24.1 g

NOPI-403-WR1 - Orange colored goethite. Jarosite lines open fracture. Variably altered tuff fragments. Sliced sides.
Wt= 8.8 g

NOPI-404-WR1 - Hematite/Goethite - orange red and black material. Black hematite covers fragments. Altered tuff fragments.
Wt= 16.2 g

4/7/94 JF

NOPI-398-WR1 - Goethite/hematite; mostly orange material. Crystalline hematite lines fracture. Jarosite also present.
Wt= 12.0 g

NOPI-406-WR1 - Goethite - orange-yellow material replaces Tuff. Hematite coats in fracture. No visible jarosite. Altered tuff fragments.
Wt= 9.8 g

NOPI-407-WR1 - Fault gouge material Fe-oxide cemented Tuff fragments. Appears mostly to be goethite - orange-yellow color.
Wt= 28.0 g

NOPI-408-WR1 - Fault gouge material. Goethite - yellow material cements tuff fragments.
Wt= 14.7 g

NOPI-409-WR1 - Goethite/hematite. Tuff fragments altered to Fe-oxides. Hematite coats fractures.
Wt = 10.3 g

NOPI-410-WR1 - Limonite tuff. Tuff fragments altered to Fe-oxides.
Wt = 11.4 g

NOPI-411-WR1 - Fault gouge material Fe-oxides (goethite) cement tuff fragments.
Wt = 15.0 g

NOPI-397-WR1 - Goethite + hematite in fracture. Some gouge material.
Wt = 3.8 g

6/8/94

NOPI-307-WR1 - Gouge fault mostly goethite, Tuff fragments cemented by Fe oxide/clay material.
Wt = 5.5 g

NOPI-413-WR1 - Fresh Nopal tuff.
Wt = 18.3 g

NOPI-412-WR1 - Fresh Nopal tuff
Wt = 10.9 g

6/10/94 Preparation of sample powder for gamma count. Samples consist of portion of whole rock powder prepared previously. Were placed in PP vials.

	wt vial	wt vial + powder	wt powder
NOPI-307-GAM1	2.074 g	5.918 g	3.844 g
NOPI-397-GAM1	2.062 g	5.567 g	3.505 g
NOPI-398-GAM1	2.055 g	6.007 g	3.952 g
NOPI-399-GAM1	2.065 g	4.957 g	2.892 g
NOPI-400-GAM1	2.070 g	3.193 g	1.123 g
NOPI-401-GAM1	2.061 g	5.627 g	3.566 g
NOPI-402-GAM1	2.075 g	5.901 g	3.826 g
NOPI-403-GAM1	2.078 g	5.754 g	3.676 g
NOPI-404-GAM1	2.056 g	5.655 g	3.599 g
NOPI-405-GAM1	2.056 g	5.882 g	3.826 g
NOPI-406-GAM1	2.066 g	5.738 g	3.672 g
NOPI-407-GAM1	2.079 g	5.830 g	3.751 g
NOPI-408-GAM1	2.060 g	5.682 g	3.622 g
NOPI-409-GAM1	2.074 g	5.708 g	3.634 g
NOPI-410-GAM1	2.067 g	5.636 g	3.569 g

NOPI-411-6AM1	2.075g	5.869g	3.794g
NOPI-412-6AM1	2.075g	5.736g	3.661g
NOPI-413-6AM1	2.069g	5.761g	3.692g

6/13/94 JP XRD analysis of Nopal rock powders

Portions of the following whole rock powders were prepared & analyzed by XRD.

NOPI-307-WR1
NOPI-398-WR1
NOPI-401-WR1
NOPI-403-WR1

Sample powders were loaded into front loading low background glass slides and taken to Div 86 for analysis on the Siemens D500 diffractometer.

After analysis powders will be placed in plastic vials and labeled as follows.

NOPI-307-XRD1
NOPI-398-XRD1
NOPI-401-XRD1
NOPI-403-XRD1

Results will be placed in a 3 ring binder entitled "Analyses of Fe-oxide bearing fractures at Nopal I, Chihuahua, Mexico".

6/20/94 gp XRD analysis - Nopal I

Portions of the following whole rock powders were prepared and analyzed by XRD

NOPI-404-WR1
NOPI-406-WR1
NOPI-408-WR1
NOPI-410-WR1

See previous page (p.203) for procedure

Sample labels:
NOPI-404-XRD1
NOPI-406-XRD1
NOPI-408-XRD1
NOPI-410-XRD1

6/20/94 XRD Analysis - Nopal I

Portions of ~~the~~ following ~~whole rock~~ samples were powdered, ~~6/20/94~~, prepared, and analyzed by XRD gp 6/20/94

NOPI-205 ~~XRD1~~ gp
NOPI-207 6/20/94
NOPI-209
NOPI-298

See page 203 for procedure

Sample labels:
NOPI-205-XRD2
NOPI-207-XRD2
NOPI-209-XRD2
NOPI-298-XRD2

OCL
6/22/94

THE FOLLOWING REAGENTS WILL BE ADDED/PREPARED FOR ISOCHRON DATING TECHNIQUE (GASCOYNE AND LAROQUE) ~~ADT~~ OCL 6/22 AND PROPERLY STORED.

- APPROXIMATELY 126.6 mL OF 15.8N HNO_3 WILL BE ADDED TO 2L GLASS BOTTLE/JUG FOLLOWED BY 1873.4 mL OF NANOPURE H_2O. THE REAGENT WILL BE LABELED AS 1M HNO_3.

- 12.6 mL OF 15.8N HNO_3 WILL BE ADDED TO A 2L GLASS JUG FOLLOWED BY 1987.4 mL OF NANOPURE H_2O. REAGENT WILL BE LABELED AS 0.1 M HNO_3.

- 1487.6 mL OF 12.1 N HCl WILL BE ADDED TO A 2L GLASS JUG FOLLOWED BY 512.4 mL OF NANOPURE H_2O. REAGENT WILL BE LABELED AS 9N HCl.

- APPROXIMATELY 16.5 mL OF 12.1 N HCl WILL BE ADDED TO A 2L GLASS JUG FOLLOWED BY 1983.5 mL OF NANOPURE H_2O. REAGENT WILL BE LABELED AS .1N HCl.

- 55.6 mL OF 36N H_2SO_4 WILL BE ADDED TO A 2L GLASS JUG FOLLOWED BY 1944.4 mL OF NANOPURE H_2O. REAGENT WILL BE LABELED AS 1M H_2SO_4.

- TO AN AMBER JUG, 50 mL OF TRI-BUTYLPHOSPHATE (TBP) WILL BE ADDED WITH 450 OF amyl acetate. SOLUTION WILL BE LABBED AS .1 TBP/amyl acetate

OCL
6/23/94

THE FOLLOWING SAMPLES WILL BE PREPARED FOR ∝ SPECTROMETRY MEASUREMENTS. THE METHOD FOLLOWED by GASCOYNE AND LAROQUE (p23) IS OUTLINED, AND DATA SHEETS ALREADY PREPARED:

- NOPI-373-WR1
- NOPI-374-WR1
- NOPI-377-WR1

6/24/94 gp

XRD Analysis - Nopal

The following samples were provided, prepared and analysed by XRD.

NOPI-334 - three separate materials from this sample were prepared by hand picking under a binocular microscope.

① Black siliceous/metallic material
Sample label NOPI-334-XRD1

② Orange clay (Fe-rich)
Sample label NOPI-334-XRD2

③ White clay/calcite material
Sample label NOPI-334-XRD3

NOPI-363 - Black clay like material.
Sample label NOPI-363-XRD1

See p203 for procedure.

6/27/94
OCL

SUBSAMPLES NOPI-373, 374, AND 377 ARE READY FOR COLUMN SEPARATION. SAMPLES FULLY DISSOLVED IN SOLUTION AND UNDERWENT SOLVENT EXTRACTION...

TIME FOR THORIUM SEPARATION : 3:00 PM, 6/27/94

TIME FOR URANIUM ELUTION : 4:15 6/27/94

7/8/94

Santorini Leachate Analysis at Div 01

Selected Santorini leachate solutions produced previously were taken to Div 01 for ICP analysis to compare results collected by AA in Div 20 and to analyze for Sn which could not be measured by standard AA technique due to its very low concentration.

About 10 ml of the following leachate were analyzed:

SAN-027 $MgCl_2$
SAN-033 $MgCl_2$
SAN-034 $MgCl_2$
SAN-041 $MgCl_2$
SAN-049 $MgCl_2$
SAN-053 $MgCl_2$

Mike Dammann (Div 01) reported that Sn + Pb could not be done by ICP because of low concentration + interference from the matrix. He attempted to analyze for Pb + Sn by graphite furnace AA (HGA) but was still unable to collect adequate information, again due to matrix interferences.

Results of ICP analyses on the other elements of interest are shown below.

DIV 20
WO#5289
20-5704-063
UNITS = ug/L

SAMPLE ID	Ag	Co	Cu	Fe	Mn	Zn
DL	15	75	10	100	10	75
SAN-027	40.6	<75	71.7	417	237	<75
SAN-033	19.7	198	23.5	355	238	<75
SAN-034	<15	398	29.0	<100	254	<75
SAN-041	15.3	266	15.2	543	192	<75
SAN-049	<15	225	19.1	1180	347	<75
SAN-053	<15	843	30.0	<100	577	<75

Correcting these values for the volume of leachate used and the weight of the sample the following results are obtained.

(ppm)

Sample ID	Ag	Co	Cu	Fe	Mn	Zn
SAN-027	.325	<.59	.566	3.29	1.87	<.6
SAN-033	.156	1.565	.186	2.81	1.88	<.6
SAN-034	<.12	3.15	.230	<.8	2.01	<.6
SAN-041	.121	2.10	.120	4.28	1.51	<.6
SAN-049	<.12	1.77	.150	9.28	2.73	<.6
SAN-053	<.12	6.69	.238	<.8	4.58	<.6

7/13/94

Gamma counting at El Paso.
Approximately 12 g of the following whole rock powders were sent to Virginia Wang at UTEP for low background gamma analysis.

NOPI-372-WR1
NOPI-379-WR1
NOPI-387-WR1
NOPI-390-WR1

In addition to these powders, EPA pitchblende + monazite standards were sent for calibration purposes. (see 031/226).

7/19/94 OCL

SAMPLES NOPI-373 AND NOPI-378 WILL BE REMEASURED ON QF- SPECTROMETER. FOLLOWING FUSION METHOD TECHNIQUE (p. 23), SAMPLE SEPARATES WILL ~~UNDEGO~~ UNDERGO A 3 STEP U/Th COLUMN SEPARATION. THE PROCEDURE IS OUTLINED BELOW:

OCL 7/19

Main Column (prewash with about 45 ml of 9M HCl)

1. Load sample onto column and wash through with about 45 ml of 9M HCl. Save this fraction for Th.
2. Elute U and Fe with 45-60 ml of 0.1M HCl.

Thorium Column (prewash with about 30 ml 8M HNO3)

1. Heat to evaporate HCl.
2. Add about 5 ml concentrated HNO3 to dissolve residue
3. Add equal volume (about 5 ml) of DI water to produce 8M HNO3 solution
4. Load Th onto column and wash with about 30 ml 8 M HNO3
5. Elute Th with about 40 ml 9M HCl
6. If visible residue remains repeat, otherwise ready for source preparation.

Uranium Column (prewash with 30 ml 8M HNO3)

1. Evaporate U fraction from main column to near dryness, pick up in about 2 ml concentrated HNO3 and dilute with about 2 ml of DI water to produce 8M HNO3 solution
2. Load onto column
3. Elute Fe and other contaminants with about 20 ml of 8M HNO3
4. Elute U with about 45 ml 0.1M HCl

THIS PROCEDURE WILL FOLLOW EXTRACTION AND DRYING OF H_2SO_4.

7/20/94 gp

Density separation of jarosite

Obj: prepare mineral separate of jarosite for age dating.

(1) Jarosite along with Fe-oxides and silicates were scraped from fracture surfaces of sample NOPI-425 collected at Nopal I.

(2) The material was ultrasonically cleaned after light crushing in a agate mortar + pestle. Supernatant was decanted to remove clay minerals in suspension. Cleaning was repeated twice.

(3) The material was filtered and dried in an oven at 50°C.

(4) Density separation using methylene iodide was performed to remove minerals with specific gravities greater than about 3.4 (eg. hematite, goethite). Jarosite has a density of about 3.2.

(5) To remove lighter specific gravity minerals such as quartz + feldspar a density separate was then performed using tetrabromoethane at a density of about 2.9.

(6) Remaing material containing mostly jarosite was filtered & placed in a plastic bottle labeled "NOPI-425-Jarosite" gp 7/20/94

OCL
7/28/94 CONTINUING WITH α-SPEC. SAMPLE PREPARATION, SPLIT SUBSAMPLES OF SAMPLES;

- NOPI-374
- NOPI-377
- NOPI-382
- NOPI-390

WILL BE PREPARED FOR α-COUNTING. THE NEW U & Th METHOD OF COLUMN SEPARATION WILL BE IMPLEMENTED; HOWEVER NEW COLUMNS WILL BE USED. FOR THE INITIAL COLUMN SEPARATION, A 13mm DIAMETER BIORAD COLUMN WITH 10cm OF ANION EXCHANGE RESIN WILL BE USED. FOR THE Th AND U FRACTION COLUMNS, A 7mm DIAMETER BIORAD COLUMN FILLED WITH 10cm OF ANION EXCHANGE RESIN IS REQUIRED.

* IN SOLVENT EXTRACTION - STEP ~~TWO~~ ONE, ONCE ORGANIC & INORGANIC PHASES ARE MIXED WELL, (~30min) THE ORGANIC BECOMES FROTHY. TO ENSURE CLEAN SEPARATION, SOLUTIONS ARE ALLOWED TO SETTLE FOR 1-2 HOURS. THIS STEP PROLONGS SAMPLE PREPARATION AND MUST ALSO BE DONE THROUGHOUT BACK EXTRACTION

OCL 7/27

8/4/94 JP

SEM/EDS analyses of TS NOPI-1-TS3

Energy dispersive microanalyses were performed to determine chemistry changes at opal/chert boundary (contact of black + yellow material). Area analyses along traverses from black material into yellow material were conducted to determine changes in the amount of U, Al, + Si.

Photos showing the locations analyzed and raw data (i.e. eds graphs) are kept in a 3 ring binder entitled "SEM + EDS Analyses of Uranium Ore Samples, Pena, BPena, & Chihuahua, Mexico".

Work done in D106 using AMRAY SEM with Tracor Northern EDS.

8/9/94 gp

Preparation of whole rock powders. Samples from the level of Nopal I; perpendicular to Northern extension of high gamma values.

Obj: powder bulk rock for gamma, deba, & XRD analysis.

Method: powder in mixer/mill

Equipment: SPEX mixer mill
Tungsten carbide vial

Procedure:

① Place portion of bulk rock sample in vial, place in mixer mill for about 15 min.

② Remove powder from vial + place in labeled plastic containers & weigh

③ Place granite chunks in vial, place on mixer mill for about 10 min To clean vial.

④ Repeat 1-3 for each sample

Samples were labeled as below:

NOPI-212-WR1 - subsample of NOPI-212.
Relatively fresh greenish-red Nopal tuff. Feldspar replaced by kaolinite. Minor Fe-oxides on fracture surfaces.
Wt= 30.8 g

NOPI-213-WR1 - subsample of NOPI-213
Altered Nopal tuff. Fe-oxides coat fracture surfaces (goethite). Kaolinite replaces feldspar + occurs in fractures.
Wt= 33.75 g

NOPI-214-WR1 - subsample of NOPI-214.
Altered lemonite tuff. Fe-oxide coat fracture surfaces (goethite) Kaolinite replaces feldspar + occurs in fractures.
Wt= 41.33 g

NOPI-215-WR1 - subsample of NOPI-215
Altered lemonite Nopal tuff. Fe-oxides (goethite) coat fractured surfaces. Kaolinite replaces feldspar + occurs in fractures.
Wt= 37.86 g

NOPI-216-WR1 - subsample of NOPI-216.
Altered hematite/lemonite tuff. Fe-oxides fill + coat fracture surfaces. Kaolinite replaced feldspars.
Wt= 39.45 g

NOPI-217-WR1 - subsample of NOPI-217.
Altered lemonite Nopal tuff. Fe-oxides coat fracture surfaces. Kaolinite replaces feldspar & occurs in fractures.
Wt= 40.30 g

NOPI-218-WR1 - subsample of NOPI-218.
Altered hematite tuff. Mottled red indicates hematization. Kaolinite replaces feldspars.
Wt= 29.25

NOPI-219-WR1 - subsample of NOPI-219:
Cream-colored Nopal tuff. Minor Fe-oxide (goethite) coat fracture surfaces. Kaolinite replaces feldspar in matrix.
Wt = 32.89 g

NOPI-220-WR1 - Subsample of NOPI-220.
Relatively fresh Nopal tuff. Minor goethite coats fracture surfaces. Kaolinite replaces feldspar.
Wt = 27.2 g

NOPI-221-WR1 - Subsample of NOPI-221.
Relatively fresh Nopal tuff. Minor Fe-oxide coat fracture surfaces. Kaolinite replaces feldspar.
Wt = 35.3 g

8/9/94 JJP Separation of jarosite from sample NOPI-418 was conducted following the procedure below.

DENSITY SEPARATION OF JAROSITE

Objective: prepare mineral separate of jarosite from rock samples collected at Nopal I

Method: density separation using heavy liquids

Materials: Nikon binocular microscope
Steel pick or exacto-knife
Agate mortar and pestle
Beakers, erlenmeyer flasks, petri dish
Millipore filter apparatus
Membrane (nylon) and paper filters
Drying oven
Methylene Iodide (lot # 911145)
Tetrabromoethane (lot# 02502012 74)
Separatory funnel

Procedure:

1. Handpick jarosite and accessory Fe-oxides and silicates from fractures and surfaces of the sample using a pick or exacto-knife. Save material in a petri dish or other container.

2. Transfer material to a mortar and crush lightly to disaggregate crystals and grains that are intergrown.

3. Transfer material to a 400 or 500 ml beaker, add about 200 ml of DI water, and ultrasonically clean for about 1 minute. Let stand for about 20-30 seconds and decant supernatant. This will remove clay minerals in suspension. Repeat the cleaning twice.

4. Dry in oven at about 50C.

5. a. Pour about 70 ml of methylene iodide (s.p. 3.4) into a 150 ml separatory funnel and add dried material.
   b. Shake solution and allow minerals with s.p. > 3.4 (e.g., hematite and goethite) to settle. Jarosite will float at or near the top of the solution.
   c. Place a flask under the separatory funnel along with a paper filter.

d. Open the separatory funnel and allow most of the liquid to drain into the flask and catch the heavy minerals on the filter paper. The remaining liquid should contain jarosite and lighter s.p. minerals. Save the methylene iodide.
e. Place the millipore filter apparatus under the separatory funnel with a membrane filter; open the separatory funnel and catch the remaining solids while vacuum filtering.
f. Wash separatory funnel while vacuum filtering. After filtering place the filter and material in a petri dish and dry in oven.
g. Repeat until all heavy minerals removed.

6. a. Pour about 70 ml of tetrabromoethane (s.p. 2.9) into a 150 ml separatory funnel and add dried material.
b. Shake solution and allow jarosite to settle. Lighter minerals will float at or near top of solution.
c. Place the millipore filter apparatus under the funnel with a membrane filter.
d. Open funnel and allow most of the tetrabromoethane to drain and catch jarosite while vacuum filtering. Save tetrabromoethane.
e. Transfer millipore apparatus to another erlenmeyer flask and wash then place filter and material in a petri dish and dry in oven.
f. Transfer tetrabromoethane to the separatory funnel and repeat until all jarosite is removed.

7. Place jarosite recovered from the above process in a plastic vial labeled "NOPI-XXX-Jar" where XXX is the number of the sample.

-Jarosite separate from NOPI-418 placed in plastic vial + labeled NOPI-418 Jar.

8/10/94 gp Preparation of Thin Sections

Obj: prepare samples for thin sections from the major E-W fracture on +10 level of Napal I at 13m N.

Equipment: Hillquist trim saw

Procedure:
① Bulk rock samples collected from the 13m N fracture were cut into thin section size blocks using the trim saw.

② These samples were placed in labeled plastic bags & sent to Mineral Optics Lab for thin section preparation.

The Mineral Optics order form is shown on the following page.

Mineral Optics Laboratory
P.O. Box 828, Wilder, Vermont 05088 — 29 "A" Street, (802) 295-9373

PETROGRAPHY ORDER CHECKLIST

Bill To: James D. Pitkyl
Address: SWRI/Div 20/Bldg 57, 6220 Culebra Rd.
City, State, ZIP: San Antonio, TX 78228

Ship To: Same
Address:
City, State, ZIP:

Date: 8/10/94 — Order No. — Customer P.O. — Received — Shipped — Phone: 210-522-5667 — Shipped via

Sample No.	Size: Quantity	27 x 46 mm	1.5 x 3 in.	2 x 3 in.	1" or 1.25 dia	Other	Thick mm	Thin mm	Standard 03 mm	Finish: Std. Lapped	1 Side Polish	2 Side Polish	Impreg.: Clear Resin	Color Resin	Grains, Cutting	Stain: Carbonate	Feldspar	Cut: Bulk Sample	Oriented	Other: Other Cement	Water Soluble	W/Cover Glass	No Cover Glass	Discard Mat'l
NOPI-417-TS1	1	✓							✓		✓			✓										
NOPI-418-TS1	1	✓							✓		✓			✓										
NOPI-418-TS2	1	✓							✓		✓			✓										
NOPI-419-TS1	1	✓							✓		✓			✓										
NOPI-420-TS1	1	✓							✓		✓			✓										
NOPI-421-TS1	1	✓							✓		✓			✓										
NOPI-422-TS1	1	✓							✓		✓			✓										
NOPI-423-TS1	1	✓							✓		✓			✓										
NOPI-424-TS1	1	✓							✓		✓			✓										
NOPI-425-TS1	1	✓							✓		✓			✓										

Polished thin sections. Impregnate with blue dyed epoxy. Use faces without "X" marks.

Thanks.

* Return remainder of all samples.

8/11/94 JP

Preparation of powders for gamma county

Obj: prepare samples for gamma county

Method - pack whole rock powders in PP vials

Equipment: PP vials (7cm)

Procedure:

① Pack whole rock powders in 7cm PP vials that were previously labeled.

② Transfer to Div 03 (F. Iddings) county lab for analysis.

③ Wt powder determined by first weighing empty vial and then weighing vial + packed powder.

Sample labels + weights are shown below.

	wt vial	wt vial + powder	wt sample
NOPI-212-GAM1	2.073 g	5.827 g	3.754 g
NOPI-213-GAM1	2.055 g	5.760 g	3.705 g
NOPI-214-GAM1	2.059 g	5.944 g	3.885 g
NOPI-215-GAM1	2.062 g	6.060 g	3.998 g
NOPI-216-GAM1	2.079 g	5.677 g	3.598 g

	wt vial	wt vial + powder	wt sample
NOPI-217-GAM1	2.065 g	5.932 g	3.867 g
NOPI-218-GAM1	2.063 g	5.783 g	3.720 g
NOPI-219-GAM1	2.073 g	5.641 g	3.568 g
NOPI-220-GAM1	2.081 g	5.844 g	3.763 g
NOPI-221-GAM1	2.071 g	5.656 g	3.585 g

8/12/94 gp Alpha spectrometry of Nopal I samples (see p 174 for procedure)

Samples
NOPI-302-WR1
NOPI-205-WR1
NOPI-142-WR1
NOPI-139-WR1

were processed + measured by alpha spectrometry.

8/15/94 gp Additional 10% TBP/amyl acetate for alpha spectrometry analysis.

Transferred 100 ml of TBP (lot # 1940-61) to a 4L colored bottle. Added 900 ml of amyl acetate to bottle + mixed (lot # 902158). Bottle labeled "10% TBP in amyl acetate".

8/16/94
OCL

THE FOLLOWING SAMPLES HAVE BEEN OR ARE BEING PREPARED FOR α-SPECTROMETRY MEASUREMENTS. THE PROCEDURE WHICH WILL BE FOLLOWING WILL INVOLVE AN ADDED COLUMN SEPARATION STEP (p 214).

- NOPI-137
- NOPI-144
- NOPI-209
- NOPI-298

DATE OF SEPARATION: 8/15/94

9/19/94 Preparation of reagents for α-spectrometry analysis

1 M HNO_3 - added 63 ml of conc HNO_3 (lot 943990) to 500 ml of H_2O in a 1L volumetric flask. Made up to mark with H_2O. Transferred solution to glass bottle (2L) and labeled "1 M HNO_3"

9/20/94 1 M H_2SO_4 - added 56 ml conc. H_2SO_4 (lot 915740) to 500 ml of H_2O in a 1L vol. flask. Made up to mark with H_2O. Transferred to glass bottle (2L) and labeled "1 M H_2SO_4"

9M HCL - added 738 ml conc HCl (lot 930085) to 200 ml H_2O in 1L vol flask. Made up to mark with H_2O. Transferred to glass bottle (2L) + labeled "9M HCl"

0.1 M HCl - added 8.2 ml conc HCl (lot 930085) to 500 ml H_2O in a 1L vol. flask. Made up to mark with H_2O. Transferred to glass bottle (2L) + labeled "0.1 M HCl"

3.0 M HNO_3 – added 504 ml conc HNO_3 (lot 943990) to 400 ml of H_2O in 1L vol flask. Made up to mark with H_2O. Transfered to 2L glass bottle labeled "3.0 M HNO_3"

0.1 M HNO_3 – added 6.3 ml conc HNO_3 (lot 943990) to 500 ml H_2O in 1L vol. flask. Made up to mark with H_2O. Transfered to 2L glass bottle labeled "0.1 M HNO_3"

ALPHA SPECTROMETRY ANALYSIS OF NOPAL I WHOLE ROCK SAMPLES

Written by: J. D. Prikryl
Date written: 09/20/94

Objective: Determine the distribution and concentration of U and Th series isotopes in powdered whole rock specimens from Nopal I

Equipment:
- EG&G Alpha Spectrometry System
  - -576A dual spectrometers or 676A single spectrometers with ion-implanted-silicon particle detectors
  - -Model 920-16 multichannel buffer
  - -ALPHAMAT analysis software for acquistion control
  - -MAESTRO II multichannel analyz emulation software for analysis of spectral data
- Analytical balance
- Heat lamp
- Muffle furnace
- Hot plate
- Propane burner

Supplies:
- Powdered whole rock samples from Nopal I
- Glassware as needed (beakers, volumetric flasks, funnels, etc)
- "SPEX"Lithium metaborate ($LiBO_2$)
- Aluminum nitrate ($Al(NO_3)_3 \cdot 9H_2O$)
- Tributylphosphate (TBP)
- Amyl acetate
- BIO-RAD anion exchange resin AG 1-X8 100-200 mesh chloride form
- BIO-RAD glass columns 1.5 cm diameter
- BIO-RAD glass columns 0.7 cm diameter
- $^{232}U/^{228}Th$ spike solution prepared previously
- Weighing paper
- Graphite crucibles
- Filter paper
- 125 ml PP bottles
- 250 ml separatory funnels
- Stainless steel planchets

Solutions:
- 1 M HNO_3
- 1 M H_2SO_4
- 9 N HCl
- 0.1 M HCl
- Conc HNO_3
- Conc HF
- 8 M HNO_3
- 0.1 N HNO_3
- 0.4 M TTA in benzene

Procedure: The U/Th Fusion procedure shown below is used to process samples.

U/Th Fusion (Nopal whole rock samples)

Sample I. D. # _____

Date _____

Fusion: Mix about 1 g of sample powder with about 3 g of "SPEX" $LiBO_2$ and add a measured aliquot (0.1 to 1.0 ml) of ^{232}U-^{228}Th spike solution in dulite HNO_3.

Weights: SPEX $LiBO_2$ (Lot # _____) _____ g

Sample powder _____ g

^{232}U-^{228}Th spike # _____ Reference Date _____

Reference Activity_____ pCi/g Spike Weight _____ g

Dry mixture under heat lamp for about 30 min, remix, and pack in graphite crucible.
Place crucible in muffle furnace at 950°C for 30 mins, then pour contents immediately into 200 ml of 1 M HNO_3 with rapid stirring. The $LiBO_2$-silicate glass formed on cooling should dissolve in about 20 mins. Filter solution to remove graphite particles and split sample into two parts (100 ml is saved in a PP bottle and the other 100 ml is analyzed for U and Th isotopes.

Extraction: To the aqueous solution, 37.5 g of $Al(NO_3)_3 \cdot 9H_2O$ is added as a salting agent, and U and Th are extracted using 25 ml of 10% tributylphosphate (TBP) solution in amyl acetate. The mixture is shaken for 30 min. to extract both U and Th into the organic phase (pour into separatory funnel, drain inorganic to waste, and save organic).

Weight: $Al(NO_3)_3 \cdot 9H_2O$ (Lot # _____) _____ g

10% TBP/amyl acetate (Lot #s _____/_____) _____ ml

U and Th are then back extracted using 4 X 25 ml of 1 M H_2SO_4 (extract, pour into separatory funnel, and save H_2SO_4).
The sulphuric acid solution is gently boiled to dryness and then heated more strongly to drive off SO_3. The dried residue is dissolved immediately in about 2 ml conc HF and diluted to 20-30 ml with 9 N HCl.

Column Separation:
Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # _____)

Main Column (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column vols 9M HCl)

Load sample in 9M HCl and allow to drain	___			
Wash 3 volumes (~35 ml) 9M HCl --> Th	___	___	___	
Elute 4 volumes (~50 ml) 0.1M HCl --> U and Fe	___	___	___	___

Separation Date _____

*Note: May work on U and Th fractions simultaneously from this point on.

Thorium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Heat Th fraction to evaporate HCl	___			
Add ~5 ml conc HNO_3 to dissolve residue	___			
Add equal vol (~5 ml) DI water so soln 8M HNO_3	___			
Load onto column in 8M HNO_3	___			
Wash 3-4 column vols 8M HNO_3	___	___	___	
Elute 4-5 column vols 9M HCl --> Th	___	___	___	___

Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Evaoprate U fraction to near dryness	___			
Pick up in about 2 ml conc HNO_3	___			
Dilute with about 2 ml DI water to approx 8M HNO_3	___			
Load onto column in 8M HNO_3	___			
Wash 2 vols (8-10 ml) 8M HNO_3 --> Fe	___	___		
Elute 4-5 vols 0.1M HCl --> U	___	___	___	___

Plating:
U and Th fractions are evaporated to near dryness; residues are each dissolved in < 5 ml 0.1 N HNO_3 and separated from daughter nuclides and trace elements carried over in TBP, by extraction into 0.4 M TTA in benzene, at pH 1 for Th and pH 3.5 for U.
The remaining solution volume is transferred to a heated stainless steel disc for evaporation to dryness. Discs are briefly flamed to red heat to remove any remaining organic and then counted.

Stainless steel disc is labeled on reverse side with Sample ID, date prepared, + initials of analyst.

U Counting Date _____

Th Counting Date_____

Results & data calculations will be kept in a 3-ring binder entitled "Alpha Spectrometry Analyses, Nopal I, Level +10".

9/19/94 gp The following samples from Nopal I were counted by alpha spectrometry using procedure on p. 231-233.

NOPI-137 - powder from NOPI-137-6AM1
NOPI-144 - powder from NOPI-144-6AM1
NOPI-209 - powder from NOPI-209-6AM1
NOPI-298 - powder from NOPI-298-6AM1.

10/7/94 gp Preparation of whole rock powders - Santorini samples.

Portions of Santorini bulk rock samples were powdered using a SPEX Mixer/Mill and Tungsten carbide vial. Samples were placed in glass or plastic containers and labeled as follows.

	wt
SAN94-039-WR1-A	93.49 g
SAN94-039-WR1-B	95.80 g
SAN94-038-WR1	51.40 g
SAN94-051-WR1	23.00 g
SAN94-024-WR1	36.59 g
SAN94-037-WR1	40.61 g
SAN94-032-WR1	44.82 g
SAN94-023-WR1	42.01 g
SAN94-017-WR1	42.25 g
SAN94-028-WR1	45.94 g
SAN94-016-WR1	45.72 g
SAN94-008-WR1	47.33 g
SAN94-012-WR1	42.51 g
SAN94-020-WR1	40.22 g
SAN94-026-WR1	42.63 g
SAN94-034-WR1	44.61 g
SAN 94-046-WR1	38.57 g
SAN94-049-WR1	43.27 g
SAN94-044-WR1	39.79 g

10/11/94 JP Akrotiri air sample analyses:

Air samples collected by B. Murphy in Aug 1994 at the Santorini analog site were taken to T.K. Tan in Div 01 for analysis of CO_2 and CH_4 content.

The samples were labeled SAN94GAS-001 thru SAN94GAS-012 and were collected in ~20 cm^3 glass vials (see scientific notebook 117 pgs 16-19 for sampling procedure).

Samples SAN94GAS-001 thru SAN94GAS-010 were delivered on 10/11/94 to Dr. Tan. The procedures he used to measure the gases will be reported when results are returned.

Samples SAN94GAS-011 and -012 will be delivered later with quality control samples that are being prepared.

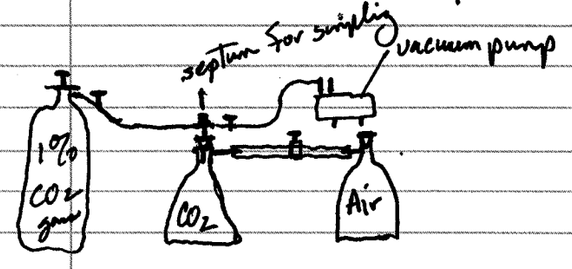
10/11/94 JP Preparation of air samples for quality control.

Obj - prepare series of air samples with varying amounts of CO_2 for quality control of Santorini air sample analyses in Div 01.

Equipment - Welch vacuum pump.

Material + supplies - ~20 cm^3 glass vials
- Erlenmeyer flasks
- tygon tubing
- Swagelock fittings
- septum fittings
- 1% CO_2 gas (certified)
- rubber stoppers
- syringe + needle - 20cc

Experimental Setup.



Procedure A

1) An erlenmeyer flask with side arm is evacuated with a vaccum pump and then filled with 1% CO_2.

2) Step 1 is repeated 5 times.

3) The erlenmeyer flask with 1% CO_2 is then connected to another erlenmeyer flask containing air to produce a known mixture of CO_2 + air.

4) The mixture is allowed to equilibrate for two days.

5) Glass vials (20 cm^3) with rubber septum is evacuated using a 20 cm^3 syringe + needle.

6) Step 5 is repeated 5 times.

7) The air mixture in the erlenmeyer flasks is drawn into a syringe (20cc) through a rubber septum attached to the sampling apparatus.

8) The air mixture in the syringe is placed in the glass vial through the rubber septum.

9) Step 7+8 are repeated 5 times. Vial is sealed with silicone + labeled.

A series of varying CO_2 to air mixtures are prepared by using different sized erlenmeyer flasks. Sizes of flasks + mixtures are shown below along with sample label.

Sample label	%CO_2	Air	
SAN94GAS-013	1000ml	1000ml	
SAN94GAS-014	1000ml	0 ml	
SAN94GAS-015	1000ml	250ml	
SAN94GAS-016	250ml	1000ml	
SAN94GAS-017	0 ml	0 ml	air only

Procedure B

1) Fixture with septum was attached directly to 1% CO_2 gas tank.

2) Glass vials (20 cm^3) with septum is evacuated using a 20 cm^3 syringe + needle.

3) Step 2 repeated 5 times.

4) Varying vol of 1% CO_2 are drawn into a 20 cm^3 syringe directly from the gas tank. The remaining vol in the syringe is filled with air to produce a CO_2/air mixture.

5) The mixture in the syringe is placed in the evacuated glass vial.

6) Steps 4 + 5 are repeated 5 times. The glass vial is sealed with silicone + labeled.

A series of CO_2/air mixtures are prepared in this way. Mixture labels + contents are defined below.

Sample label	1% CO_2	Air
SAN 94 GAS-018	100%	
SAN 94 GAS-019	50%	50%
SAN 94 GAS-020	70%	30%
SAN 94 GAS-021	40%	60%

10/13/94 gp Thin sections of samples from EW fracture on level +10 were received from Mineral Optics.

See pgs. 223 + 224 for separation procedure + order form. + sample ID's.

10/13/94 gp Jarosite separated from sample NOPI-423. Procedure on p221 used to separate the jarosite.

Sample placed in plastic vial + labeled NOPI-423-Jar.

10/17/94 gp Jarosite separated from sample NOPI-417. Procedure on p221 used to separate the jarosite

Sample placed in plastic vial + labeled NOPI-417-Jar.

10/18/94 gp Samples SAN94GAS-011 and -012 plus quality control sample SAN94GAS-013 thru 021 were delivered to Dr Tan in Div 01 for CO_2 + CH_4 analysis.

10/18/94 gp Powders of bulk fracture material from samples along major EW fracture at 13m N were separated by scraping with an steel knife. Fracture material was placed in agate mortar + ground to a powder. Powders were placed in plastic vials + labeled as NOPI-XXX-WR1.

Sample labels are as follows:

NOPI-417-WR1
NOPI-418-WR1
NOPI-419-WR1
NOPI-420-WR1
NOPI-421-WR1
NOPI-422-WR1
NOPI-423-WR1
NOPI-424-WR1
NOPI-425-WR1.

Powder will be used for XRD, alpha, and gamma analyses.

10/19/94 gp XRD of bulk fracture powders

Powders of bulk fracture material from the EW fracture at 13m N prepared on previous page were prepared and analyzed by XRD.

Powders were packed in front mounty glass XRD holders. XRD analysis was done in Div 01 using the Siemens D500 x-ray diffractometer and Jade software.

Results are kept in 3 ring binder entitled "Analysis of Fe-Oxide Bearing Fracture at Nopal I, Chihuahua, Mexico"

XRD samples were labeled as follows:

NOPI-417-XRD2
NOPI-418-XRD2
NOPI-419-XRD2
NOPI-420-XRD2
NOPI-421-XRD2
NOPI-422-XRD2
NOPI-423-XRD2
NOPI-424-XRD2
NOPI-425-XRD2

After analyses powders used were returned to the whole rock powder sample container.

10/19/94 gp Reagent preparation for selective leaching experiments:

1M $MgCl_2$ - add 203.31g of $MgCl_2$ (lot 936845) to 500 ml H_2O in volumetric beaker. Dissolve, make up to 1000 ml mark with H_2O. Transfer soln to a 1L bottle labeled "1M $MgCl_2$".

1M NaOAc (pH=5) = dissolve 136.08g of NaOAc (lot 973077) in 500ml H_2O in 1L beaker. Make up to 1000 ml with H_2O. Add dropwise acetic acid (HOAc) lot (943002) until pH=5 is reached. Transfer solution to 1L PP bottle labeled "1M NaOAc; pH=5"

0.04M $NH_2OH \cdot HCl$ in 25% (v/v) HOAc.

- transferred 250 ml HOAc (lot 943002) to a 1L volumetric flask containing about 600 ml H_2O and mixed. Added 2.7796 g $NH_2OH \cdot HCl$ (lot 91265 3A) and dissolved. Made soln up to mark with H_2O. Transferred soln to a 1L PP bottle labeled "0.04M $NH_2OH \cdot HCl$".

10/19/94 gp

SELECTIVE LEACHING OF SANTORINI SAMPLES

Objective: determine partitioning of particulate trace metals in rock samples collected at the Santorini analog site

Method: sequential leaching (see Tessier et al., 1979)

Equipment:
- Perkin-Elmer Model 3100 Atomic Absorption Spectrometer
- Fisher Marathon 21K centrifuge
- Burrell wrist shaker
- Thermolyne drying oven
- Ohaus analytical balance
- Hand homogenizer (SI Vortex Genie-2)
- Fisher Model 236 waterbath

Materials and Supplies:
- 50 ml polyporpylene (PP) centrifuge tubes
- glassware as needed (e.g., petri dishes, beakers, flasks, etc...)
- Oxford adjustable pipeters and 10 and 5 ml PP tips
- platicware as needed (e.g., beakers, PP bottles)
- Dynagrad syringe filters and syringes
- Eppendorf pipets and tips

Reagents:
- 1 M MgCl2
- 1 M NaOAc adjusted to pH = 5 with acetic acid (HOAc)
- 0.04 M NH2OH-HCl in 25% (v/v) HOAc
- 100 ppm Cu standard solution
- 100 ppm Ag standard solution
- 100 ppm Co standard solution
- 100 ppm Zn standard solution
- 100 ppm Pb standard solution
- 100 ppm Fe standard solution
- 100 ppm Mn standard solution
- 1.5 ml HNO2/1 L H2O

Leaching Procedure:

1. Place about 10 g of powdered whole rock sample (e.g. SAN94-038-WR1) into petri dish and place in drying oven at 100°C for about 24 hrs.

2. Label (e.g., SAN94-038-WR1A or B or C etc...) and weight 4 50 ml PP centrifuge tubes. Record weights.

3. Place about 1 g of sample powder into each of the 50 ml centrifuge tubes and weight. Record weights. Difference between weight of empty tube and weight of tube + powder is weight of powder.

4. Add 8 ml of 1 M MgCl2 (pH = 7) to each centrifuge tube using an Oxford pipeter and 10 ml PP tip. Place tubes on wrist shaker and continuously agitate for 1 hour.

5. Centrifuge tubes at 10,000 rpm for 30 minutes.

6. Remove supernatant from each tube by pipeting (Oxford pipeter and 5 ml PP tips) and place in PP beaker. Filter combined supernatant (Dynagrad syringe filters) to remove any suspended material. Place filtered supernatant in 60 ml PP bottle and label (e.g., SAN94-038 MgCl2).

7. Wash residue in centrifuge tubes with DI water by adding 8 ml of DI water to each tube, agitate on homogenizer, and centrifuge at 10,000 rpm for 30 minutes. Decant supernatant.

8. Add 8 ml of 1 M NaOAc adjusted to a pH of 5 with acetic acid (HOAc) to each centrifuge tube using an Oxford pipeter and 10 ml PP tip. Place tubes on wrist shaker and continuously agitate for 5 hours.

9. Repeat steps 5 thru 7. (Label bottles e.g., SAN94-038 NaOAc).

10. Add 10 ml of 0.04 M NH2OH-HCl in 25% (v/v) HOAc to each centrifuge tube using an Oxford pipeter and 10 ml PP tip. Weigh and record weight of each tube. Place tubes in water bath at 96°C for 5 hrs. Samples should be agigated occasionally (once per hour). Remove tubes, allow to cool, and then reweigh. Difference in weights of tube before and after heating is amount of solution lost during heating.

11. Repeat steps 5 thru 7. (Label bottles e.g., SAN94-038 NH2OH).

12. Remaining residue in tubes are saved.

Analysis Procedure:

1. Cu, Ag, Co, Pb, Zn, Fe, and Mn in the leachates are analyzed by AA using standard additions method to avoid matrix interferences. All samples for AA analysis were made up in volumetric flasks. Unless otherwise specifed in the scientific notebook the table below shows for each element the volume leachate taken for analysis and the volume additions of 100 ppm standards made to each leachate. Dilution factors for Cu, Co, Ag, Zn, and Pb were 1/2 for all reagents. Dilution factors for Fe and Mn were 1/10 for 1M MgCl2 and 1M NaOAc and 1/25 for 0.04 M NH2OH-HCl. All leachates were diluted using a 1.5 ml HNO3/1 L H2O solution.

Element	Samp. vol.	Additions (ml added/ppm)						Total vol
		10 ml (MgCl2 and NaOAc)			25ml (NH2OH-HCl)			
		A	B	C	A	B	C	
Cu	5 ml	0/0	.1/1	.2/2				10 ml
Co	5 ml	0/0	.1/1	.2/2				10 ml
Ag	5 ml	0/0	.1/1	.2/2				10 ml
Pb	5 ml	0/0	.1/1	.2/2				10 ml
Zn	5 ml	0/0	.05/.5	.1/1				10 ml
Fe	1 ml	0/0	.1/1	.2/2	0/0	.25/1	.5/2	10 or 25 ml
Mn	1 ml	0/0	.05/5	.1/1	0/0	.125/.5	.25/1	10 or 25 ml

2. Conditions for AA analysis are shown below. All samples were run in flame mode.

Element	nm (λ)	nm slit	Lamp
Cu	324.8	0.7	Multi Cu, Zn, Mn, Fe
Co	240.7	0.2	Single Co
Ag	328.1	0.7	Single Ag
Pb	283.3	0.7	Single Pb
Zn	213.9	0.7	Multi Cu, Zn, Mn, Fe
Fe	248.3	0.2	Multi Cu, Zn, Mn, Fe
Mn	279.5	0.2	Multi Cu, Zn, Mn, Fe

3. Raw data, calculations, and results of the analyses are kept in 3 ring binders entitled "Metals Leaching Data, Santorini, Greece".

10/19/94 gp Santorini leaching -

6 1g samples of SAN94-039-WR1-A and SAN94-038-WR1 were placed in preweighed 50 ml PP centrifuge tubes + labeled as below.

	wt tube (g)	wt tube + powder (g)	wt powder (g)
SAN94-039-WR1-A-A	13.710	14.725	1.015
" -B	13.664	14.678	1.014
" -C	13.683	14.695	1.012
" -D	13.745	14.761	1.016
" -E	13.592	14.605	1.013
" -F	13.581	14.602	1.021
SAN94-038-WR1-A	13.788	14.806	1.018
" -B	13.665	14.677	1.012
" -C	13.742	14.763	1.021
" -D	13.653	14.666	1.013
" -E	13.852	14.862	1.010
" -F	13.693	14.702	1.009

Samples were leached and analyzed for trace metals using procedure on p 245 + 247.

10/24/94 Santorini leaching

Samples of SAN94-039-WR1-B, SAN94-032-WR1, and SAN94-051-WR1 were placed in preweighed 50 ml PP centrifuge tubes + labeled as below

	wt tube	wt tube + powder	wt powder
SAN94-039-WR1-B-A	13.839	14.856	1.017
" -B	13.691	14.703	1.012
" -C	13.592	14.610	1.018
" -D	13.707	14.747	1.040
SAN94-051-WR1-A	13.906	14.419	0.513
" -B	13.733	14.246	0.513
" -C	13.744	14.246	0.502
" -D	13.713	14.237	0.524
SAN94-032-WR1-A	13.744	14.760	1.016
" -B	13.657	14.698	1.041
" -C	13.692	14.723	1.031
" -D	13.724	14.759	1.035

Samples were leached and analyzed using procedure on p 245 + 247.

10/24/94 gp Sentovini leaching

Samples of SAN94-037-WR1, SAN94-024-WR1 and SAN94-023-WR1 were placed in 50 ml PP centrifuge tubes + labeled as below:

		wt tube	wt tube + powder	wt powder
SAN94-037-WRI-A		13.693	14.727	1.034
"	B	13.754	14.782	1.028
"	C	13.794	14.839	1.045
"	D	13.737	14.764	1.027
SAN94-024-WRI-A		13.754	14.773	1.019
"	B	13.673	14.710	1.037
"	C	13.658	14.708	1.050
"	D	13.685	14.709	1.024
SAN94-023-WRI-A		13.653	14.675	1.022
"	B	13.787	14.821	1.034
"	C	13.745	14.784	1.039
"	D	13.655	14.689	1.034

Samples were processed w/ procedure on p245-247.

10/24/94 gp NH_2OH-HCl leach step weights

Sample	wt after 20ml reagent added	wt after leaching	wt reagent lost
SAN94-039-WRI-A	35.41	33.78	1.63
" B	35.73	33.56	2.17
" C	35.48	33.84	1.64
" D	35.63	33.65	1.98
" E	35.23	35.74	-.51
" F	35.42	34.51	0.91
SAN94-038-WRI-A	35.71	33.48	2.23
" B	35.53	32.38	3.15
" C	35.90	33.53	2.37
" D	35.56	33.12	2.44
" E	35.63	33.07	2.56
" F	35.60	33.12	2.48

10/25/94 gf Preparation of whole rock powders - Santorini

Portions of Santorini bulk rock samples were powdered using a SPEX mixer/mill + tungsten carbide vial. Samples were placed in plastic containers & labelled as follows:

	wt.
SAN94-045-WR1	44.63g
SAN94-047-WR1	42.88g
SAN94-036-WR1	41.56g
SAN94-033-WR1	42.19g
SAN94-025-WR1	15.05g
SAN94-021-WR1	43.64g
SAN94-018-WR1	41.48g
SAN94-010-WR1	44.53g
SAN94-014-WR1	3.24g
SAN94-031-WR1	41.62g
SAN94-029-WR1	87.25g
SAN94-050-WR1	3.10g

10/25/94 gf Santorini leaching

Samples of SAN94-012-WR1, SAN94-020-WR1, & SAN94-028-WR1 were placed in 50 ml PP centrifuge tubes & labeled as below:

		wt tube	wt tube + powder	wt powder
SAN94-012-WR1-A		13.751	14.767	1.016
"	B	13.717	14.747	1.030
"	C	13.663	14.700	1.037
"	D	13.602	14.646	1.044
SAN94-020-WR1-A		13.662	14.703	1.041
"	B	13.774	14.805	1.031
"	C	13.751	14.774	1.023
"	D	13.726	14.752	1.026
SAN94-028-WR1-A		13.699	14.734	1.035
"	B	13.867	14.907	1.040
"	C	13.750	14.770	1.020
"	D	13.782	14.810	1.028

Samples were leached and analyzed using procedures on p 245-247

10/25/94 gp Suntarini leach

Sample of SAN94-008-WR1, SAN94-016-WR1 and SAN94-017-WR1 were placed in 50 ml PP centrifuge tubes + labeled as below:

		wt tube	wt tube + powder	wt powder
SAN94-008-WR1-A		13.781	14.812	1.031
"	B	13.791	14.816	1.025
"	C	13.671	14.694	1.023
"	D	13.775	14.816	1.041
SAN94-016-WR1-A		13.737	14.771	1.034
"	B	13.659	14.681	1.022
"	C	13.678	14.698	1.020
"	D	13.744	14.776	1.032
SAN94-017-WR1-A		13.640	14.668	1.028
"	B	13.704	14.724	1.020
"	C	13.809	14.840	1.031
"	D	13.795	14.839	1.044

Samples leached and analyzed using procedure on pg 245-247

10/26/94 gp $NH_2OH \cdot HCl$ leach step weights

Sample		wt after 10ml reagent added	wt after leach	wt reagent lost
SAN94-037-WR1-A		25.31	24.83	0.48
"	B	25.56	24.70	0.86
"	C	25.62	24.80	0.82
"	D	10/26 gp ~~25.93~~ 25.74	24.97	0.77
SAN94-024-WR1-A		25.50	24.78	0.72
"	B	25.42	24.75	0.67
"	C	25.42	24.81	0.61
"	D	25.41	24.63	0.78
SAN94-023-WR1	A	25.29	24.67	0.62
"	B	25.45	24.71	0.74
"	C	25.42	24.66	0.76
"	D	25.24	24.63	0.61
SAN94-051-WR1-A		25.11	24.39	0.72
"	B	24.78	24.13	0.65
"	C	24.84	24.08	0.76
"	D	24.81	23.98	0.83
SAN94-039-WR1-B-A		25.53 gp 10/26 ~~25.35~~	24.78	0.75
"	B	~~25.22~~	24.52	0.83
"	C	25.24	24.58	0.66
"	D	25.22	24.31	0.91
SAN94-032-WR1-A		25.47	24.69	0.78
"	B	25.47	24.82	0.65
"	C	25.38	24.75	0.63
"	D	25.34	24.75	0.59

10/26/94 JP Santarini leach

Samples of SAN94-034-WR1, SAN94-039-WR1-A, and SAN94-038-WR1 were placed in 50 ml PP centrifuge Tubes + labeled as follows:

		wt tube	wt tube + powder	wt powder
SAN94-034-WR1-A		13.684	14.720	1.036
"	B	13.692	14.732	1.040
"	C	13.690	14.711	1.021
"	D	13.700	14.730	1.030
SAN94-039-WR1-A-A		13.744	14.773	1.029
"	B	13.939	14.958	1.019
"	C	13.721	14.740	1.019
"	D	13.694	14.734	1.040
SAN94-038-WR1-A		13643	14.672	1.029
"	B	13.665	14.689	1.024
"	C	13.821	14.850	1.029
"	D	13942	14.976	1.034

Simples were leached and analyzed using procedure on pp 245-247.

10/26/94 JP Santarini leach

Samples of SAN-033-WR1, SAN-030-WR1, and SAN-031-WR1 were placed in 50 ml centrifuge Tubes + labeled as follows:

		wt tube	wt tube + powder	wt powder
SAN-033-WR1-A		13.693	14.729	1.036
"	B	13.764	14.805	1.041
"	C	13.760	14.782	1.022
"	D	13.712	14.730	1.018
SAN-031-WR1-A		13.736	14.771	1.035
"	B	13.705	14.734	1.029
"	C	13.714	14.740	1.026
"	D	13.856	14.886	1.030
SAN-030-WR1-A		13.842	14.856	1.014
"	B	13.629	14.652	1.023
"	C	13.802	14.814	1.012
"	D	13.700	14.736	1.036

Simples were leached + analyzed using procedure on pp 245-247.

10/27/94 gp

$NH_2OH \cdot HCl$ leach step weights

Sample		wt after 10m reagent added	wt after leach	wt reagent lost
SAN94-012-WR1-A		25.51	25.27	0.24
"	B	25.39	25.18	0.18
"	C	25.26	25.01	0.25
"	D	25.19	24.95	0.20
SAN94-028-WR1-A		25.43	25.27	0.16
"	B	25.37	25.19	0.18
"	C	25.44	25.20	0.22
"	D	25.43	25.13	0.30
SAN94-020-WR1-A		25.38	25.18	0.20
"	B	25.58	25.29	0.29
"	C	25.50	24.90	0.60
"	D	25.43	24.70	0.73
SAN94-016-WR1-A		25.41	24.89	0.52
"	B	25.38	~~25.33~~ 25.18 gp 10/27	0.20
"	C	25.28	25.02	0.26
"	D	25.43	25.33	0.10
SAN94-017-WR1-A		25.38	25.12	0.26
"	B	25.45	24.79	0.66
"	C	25.58	25.25	033
"	D	25.60	25.47	0.13
SAN94-008-WR1-A		25.52	24.93	0.59
"	B	25.54	24.88	0.66
"	C	25.38	25.20	0.18
"	D	25.43	25.10	0.33

10/27/94 gp

Santoni leach

Samples of SAN94-044-WR1, SAN94-047-WR1, and SAN94-043-WR1 were placed in 50 ml PP centrifuge tubes + labeled as follows:

		wt tube	wt tube + powder	wt powder
SAN94-047-WR1-A		13.806	14.852	1.046
"	B	13.677	14.720	1.043
"	C	13.775	14.796	1.021
"	D	13.734	14.759	1.025
SAN94-044WR1-A		13.597	14.617	1.020
"	B	13.754	14.780	1.026
"	C	13.657	14.687	1.030
"	D	13.446	14.988	1.042
SAN94-043-WR1-A		13.737	14.754	1.017
"	B	13.607	14.626	1.019
"	C	13.758	14.801	1.043
"	D	13.776	14.825	1.049

Samples were leached and analyzed using procedure on p 245-247.

10/27/94 gp Santorini Iearly

Samples of SAN94-036-WR1, SAN94-045-WR1, and SAN94-049-WR1 were placed in 50 ml centrifuge tubes & labeled as below:

		wt tube	wt tube + powder	wt powder
SAN94-036-WR1-A		13.682	14.703	1.021
"	B	13.853	14.872	1.019
"	C	13.683	14.703	1.020
"	D	13.863	14.889	1.026
SAN94-045-WR1-A		13.776	14.801	1.025
"	B	13.670	14.693	1.023
"	C	13.866	14.914	1.048
"	D	13.672	14.691	1.019
SAN94-049-WR1-A		13.719	14.764	1.045
"	B	13.696	14.727	1.031
"	C	13.761	14.790	1.029
"	D	13.688	14.718	1.030

Samples were leached & analyzed using procedures on p 245-247.

10/27/94 gp Santorini Iearly

Samples of SAN94-033-WR1, SAN94-018-WR1, and SAN94-010-WR1 were placed in 50 ml centrifuge tubes & labeled as below.

		wt tube	wt tube + powder	wt powder
SAN94-033-WR1-A		13.724	14.759	1.035
"	B	13.862	14.889	1.027
"	C	13.972	15.001	1.029
"	D	13.731	14.758	1.027
SAN94-018-WR1-A		13.669	14.688	1.019
"	B	13.861	14.901	1.040
"	C	13.691	14.716	1.025
"	D	13.703	14.738	1.035
SAN94-010-WR1-A		13.647	14.675	1.028
"	B	13.763	14.801	1.038
"	C	13.699	14.734	1.035
"	D	13.815	14.851	1.036

Samples were leached and analyzed using procedures on pp 245-247

10/27/94 JP Santa Ynez

10/27 JP

Samples of SAN94-027-WR1, SAN-022-WR1, and SAN94-025-WR1 were placed in 50 ml centrifuge tubes + labeled as below.

		wt tube	wt tube + powder	wt powder
SAN-022-WR1-A		13.737	14.773	1.036
"	B	13.666	14.694	1.028
"	C	13.651	14.683	1.032
"	D	13.824	14.858	1.034
SAN-027-WR1-A		13.781	14.814	1.033
"	B	13.689	14.710	1.021
"	C	13.999	15.033	1.034
"	D	13.811	14.834	1.023
SAN94-025-WR1-A		13.717	14.729	1.012
"	B	13.693	14.717	1.024
"	C	13.719	14.755	1.036
"	D	13.874	14.904	1.030

Samples were leached + analyzed using procedures on pp 245-247. ()

10/28/94 JP Santa Ynez

Samples of SAN94-031-WR1, SAN94-029-WR1, and SAN94-014-WR1 were placed in 50 ml centrifuge tubes + labeled as below:

		wt tube	wt tube + powder	wt powder
SAN94-031-WR1-A		13.762 JP ~~13.951~~ 10/28	14.799	1.037
"	B	13.914	14.930	1.016
"	C	13.943	14.972	1.029
"	D	13.951	14.990	1.039
SAN94-029-WR1-A		13.777	14.819	1.042
"	B	13.811	14.836	1.025
"	C	13.722	14.756	1.034
"	D	13.734	14.765	1.031
SAN94-014-WR1-A		13.762	14.792	1.030
"	B	13.741	14.787	1.046
"	C	13.697	14.735	1.038
"	D	13.805	14.824	1.019

Samples were leached and analyzed using procedures on pp 245-247. ()

10/28/94 gp Santorini leachj

Samples of SAN94-021-WR1, SAN94-026-WR1, and SAN94-046-WR1 were placed in 50 ml PP centrifuge tubes & labeled as below.

		wt tube	wt tube + powder	wt powder
SAN94-021-WR1-A		13.709	14.749	1.040
"	B	13.711	14.753	1.042
"	C	13.694	14.712	1.018
"	D	13.692	14.723	1.031
SAN94-026-WR1-A		13.791	14.815	1.024
"	B	13.666	14.692	1.026
"	C	13.779	14.804	1.025
"	D	13.691	14.719	1.028
SAN94-046-WR1-A		13.752	14.791	1.039
"	B	13.777	14.817	1.040
"	C	13.865	14.892	1.027
"	D	13.687	14.726	1.039

Samples were leached and analyzed using procedures on pp 245-247.

2/8/94 gp Preparation of metal standards

100 ~~to~~ gp 2/28/94

Obj: prepare ~~100~~ ppm metal standards to be used in analyzing Santorini leachates.

Method: dilute 1000 ppm AA reference Standards

Materials:

1000 ppm Cu ref. std. (lot NO 935150-24)
1000 ppm Ag ref. std. (lot NO 932877-9)
1000 ppm Zn ref. std. (lot NO 932351-24)
1000 ppm Co ref. std. (lot NO 940162-24)
1000 ppm Pb ref. std. (lot NO 925795-24)
1000 ppm Mn ref. std. (lot NO 930061-24)
1000 ppm Fe ref. std. (lot NO 932993-24)
concentrated HNO_3
100 ml volumetric flasks
~~1~~ 10 ml volumetric pipets
125 ~~250~~ ~~125~~ ml 10/28 gp PP bottles
1L vol flask

Procedure: 10 gp 10/28/94

1) Rinse ~~10~~ ml pipet with ref std, then transfer 10 ml of std. into a 100 ml volumetric flask, dilute to mark with a solution of 1.5 ml HNO_3 / 1L H_2O to maintain Standard matrix

125 ~~250~~ gp 10/28/94

2) Transfer solution to a ~~125~~ ml PP bottle & label appropriately. Repeat to make 200 ml.

3). If necessary, serial dilutions or more dilutions can be made by following previous procedure.

10/31/94 gp $NH_2OH \cdot HCl$ (each step wts.

Sample		wt after 10ml reagent added	wt after leach	wt reagent lost
SAN94-045-WRI-A		25.52	~~25.22~~ 25.02	0.30
"	B	25.23	~~25.26~~ gp 10/31 25.35	0.21
"	C	25.58	~~25.19~~ gp 10/31 25.10	0.23
"	D	25.23	~~25.32~~ gp 10/31	0.13
SAN94-049-WRI-A		25.34	25.03	0.31
"	B	25.30	25.26	0.04
"	C	25.44	25.31	0.13
"	D	25.29	25.18	0.11
SAN94-036-WRI-A		25.36	25.16	0.20
"	B	25.53	25.26	0.27
"	C	25.35	25.19	0.16
"	D	25.59	25.32	0.27
SAN94-047-WRI-A		25.42	25.02	0.40
"	B	25.35	25.09	0.26
"	C	~~25.42~~ 25.44	25.29	0.13
"	D	~~25.57~~ gp 10/31	25.14	0.30
SAN94-043-WRI-A		25.43	25.27	0.17
"	B	25.36	25.25	0.11
"	C	25.42	25.32	0.30
"	D	25.75	25.49	0.26
SAN94-044-WRI-A		25.28	25.12	0.16
"	B	25.38	25.13	0.25
"	C	25.32	25.13	0.19
"	D	25.57	25.32	0.25

10/31/94pp Results of CO_2 + CH_4 analysis of Interim air samples (p236-240)

Analysis method
CO_2 + CH_4 by TCD (chromatography)

Southwest Research Institute
Project No.: 20-5704-083
Work Order No. 6041

Client: Division 20 SDG: 001

Carbon Dioxide & Methane Analysis

Date Received: 10/11/94 Date Analyzed: 10/18/94

Matrix: Air
Concentration Units: ppm

Client Sample ID	Lab Sample ID	CO2	METHANE
001	46660	377	ND
002	46661	264	ND
003	46662	633	ND
004	46663	511	ND
005	46664	526	ND
006	46665	681	ND
007	46666	478	ND
008	46667	391	ND
009	46668	472	ND
010	46669	428	ND

All values were based on the following standards

Standard	PPM	Balance	Accuracy	Notes
Carbon Dioxide	1000	Nitrogen	±2%	----
Methane	95	Helium	±2%	Mix 213

Southwest Research Institute
Project No.: 20-5704-083
Work Order No. 6065

Client: Division 20 SDG: 011

Carbon Dioxide & Methane Analysis

Date Received: 10/18/94 Date Analyzed: 10/24/94

Matrix: Air
Concentration Units: ppm

Client Sample ID	Lab Sample ID	CO2	METHANE
011	46793	674	ND
012	46794	202	ND
013	46795	6873	ND
014	46796	8582	ND
015	46797	8034	ND
016	46798	1866	ND
017	46799	477	ND
018	46800	10866	ND
019	46801	5721	ND
020	46802	7252	nd
021	46803	3702	ND

All values were based on the following standards

Standard	PPM	Balance	Accuracy	Notes
Carbon Dioxide	1000	Nitrogen	±2%	----
Methane	95	Helium	±2%	Mix 213

Client Sample ID 001 thru 021 = SAN94GAS-001 thru SAN94GAS-021

11/1/94 gp $NH_2OH \cdot HCl$ leach step wts.

Sample	wt after 10mM reagent added	wt after leach	reagent lost
SAN94-034-WR1-A	25.10	25.04	0.06
" B	25.44	25.16	0.24
" C	25.37	25.30	0.07
" D	24.82	24.74	0.08
SAN94-038-WR1-A	~~25.29~~ 25.17 gp 11/1	25.04	0.13
" B	25.29	25.11	0.18
" C	25.36	25.16	0.20
" D	25.48	25.39	0.09
SAN94-035-WR1-A gp 11/1	25.14	25.02	0.12
" B	25.32	25.06	0.26
" C	25.05	24.81	0.24
" D	25.07	24.97	0.10
SAN-033-WR1-A	~~25.39~~ 25.53 gp 11/1	~~24.91~~ 25.32 gp 11/1	0.21
" B	25.39	25.30	0.09
" C	25.36	25.20	0.16
" D	25.41	25.39	0.02
SAN-030-WR1-A	25.34	25.41	-0.07
" B	25.38	25.32	0.06
" C	25.41	25.37	0.04
" D	25.27	25.32	-0.05
SAN-031-WR1-A	25.53	25.69	-0.16
" B	25.39	25.14	0.25
" C	25.62	25.54	0.08
" D	25.66	25.53	0.13

11/1/94 gp $NH_2OH \cdot HCl$ leach step wts.

Sample gp 1/11	wt after 10mM reagent added	wt after leach	reagent lost
SAN94-~~043~~ 010-WR1-A	25.41	25.26	0.15
" B	25.52	25.43	0.11
" C	25.43	25.24	0.19
" D	25.74	25.63	0.11
SAN94-~~047~~ 033 gp 1/11 -WR1-A	25.09	24.91	0.18
" B	25.43	25.25	0.18
" C	25.64	25.48	0.16
" D	25.33	25.17	0.16
SAN94-~~044~~ 018 gp 1/11 -WR1-A	25.45	25.52	-0.07
" B	25.53	25.39	0.14
" C	25.46	25.24	0.22
" D	25.55	25.35	0.20
SAN94-~~045~~ 025 gp 1/11 -WR1-A	25.38	24.58	0.80
" B	25.30	~~24.99~~ 25.18 gp 11/2	0.12
" C	25.47	25.27	0.20
" D	25.68	~~25.36~~ 25.44 gp 11/2	0.24
SAN94-~~036~~ SAN-022 gp 1/11 -WR1-A	26.30	26.06	0.24
" B	25.97	25.56	0.41
" C	26.14	25.70	0.44
" D	26.25	25.85	0.40
~~SAN94-049-WR1-A~~ SAN-027 gp 1/11	25.74	25.49	0.25
" B	25.73	25.46	0.27
" C	25.97	25.76	0.21
" D	25.59	25.44	0.15

11/2/94 $NH_2OH \cdot HCl$ leach step wts

Sample		wt after 10ml reagt added	wt after leach	wt reagt lost
SAN94-029-WRI-A		25.81	25.56	0.25
"	B	25.70	25.25	0.45
"	C	25.72	25.52	0.20
"	D	25.64	25.46	0.18
SAN94-031-WRI-A		25.43	25.30	0.13
"	B	25.40	25.105	0.35
"	C	25.52	25.22	0.30
"	D	25.65	25.44	0.21
SAN94-014-WRI-A		25.49	25.17	0.31
"	B	25.50	25.33	0.17
"	C	25.54	25.33	0.21
"	D	25.59	25.33	0.26
SAN94-026-WRI-A		25.44	25.18	0.26
"	B	25.15	24.90	0.25
"	C	25.41	25.11	0.30
"	D	25.27	25.12	0.15
SAN94-021-WRI-A		~~25.49~~ 25.53 pp 11/2	25.26	0.27
"	B	25.47	25.11	0.36
"	C	25.58	25.20	0.38
"	D	25.50	25.29	0.21
SAN94-046-WRI-A		25.53	25.22	0.31
"	B	25.63	25.55	0.08
"	C	25.61	25.28	0.32
"	D	25.49	25.41	0.08

11/10/94 AA analysis of NaOAc & $NH_2OH \cdot HCl$ leachates for sample SAN94-051 for Cu

High Cu contents of these leachates precluded measurement by standard addition method (p 245) therefore a linear calibration was prepared by AA to measure these leachates.

Obj - measure Cu content of Sample SAN94-051.

Method - AA analysis - linear fit

Materials -
- volumetric flasks
- eppendorf pipets + tips
- glassware + plastic-ware as needed
- 9.5 ml HNO_3 / 1L H_2O - 100 ppm Cu ~~standard~~

Equipment - PE Model 3100 AA

Procedure -

① 1, 2, and 5 ppm Cu standards were prepared by diluting the 100 ppm Cu standard (p 245) in 100 ml volumetric flasks.

② 1 ml of NaOAc and $NH_2OH \cdot HCl$ leachates for sample SAN94-051 were placed in 1L volumetric flasks and flasks were made up to mark with 1.5 ml HNO_3 / 1L H_2O. This gave a dilution factor of 1000.

(3) A linear calibrate was prepared on the AA using standard prepared in ~~step~~ 1.

(4) Sample leachates were measured and their concentrations are shown below.

Sample SAN94-051	ppm
$NaOAc$ leachate	.210
$NH_2OH \cdot HCl$ leachate	.331

Calculation of concentration

$.210 \times 1000 \times 8 / .513 = 3274.85$ ppm

$.331 \times 1000 \times 8 / .513 = 5974.78$ ppm

11/10/94 Results of leaching experiments conducted up to this date.

Santorini Leaching Results

SAMPLE NO.	MgCl2 exchangeable								Carbonate fraction								Fe-Mn oxides							
	Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn	Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn	Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn
Profiles																								
(Hole I)																								
SAN-021	1.05	0.94	4.87	5.91	0.57		5.50	5.67	1.49	1.50	5.30	4.71	1.36		0.00	13.55	2.12	0.00	7.15	5.52	4.13		62.09	83.32
SAN-028	1.24	0.83	4.25	5.41	0.55		1.13	4.25	2.99	0.70	4.84	4.75	1.17		0.00	15.82	1.86	0.00	2.45	4.52	3.27		127.45	34.45
SAN-036	1.11	0.83	6.19	6.47	0.59		1.52	3.75	1.83	0.84	4.79	3.88	1.76		8.43	8.32	0.70	0.00	1.91	4.49	1.62		121.81	13.43
SAN-044	0.74	0.97	4.76	4.94	0.52		3.63	4.53	1.53	0.82	5.03	4.69	1.76		9.86	7.28	0.65	0.15	1.67	4.67	1.51		74.87	10.55
(Hole II)																								
SAN-022	0.68	0.47	4.48	1.06	0.37		2.68	11.67	1.27	0.65	5.86	1.94	1.38		0.00	18.48	1.43	0.19	8.91	0.63	5.92		61.80	125.71
SAN-029	1.02	0.66	4.19	2.88	0.27		2.99	5.62	1.60	0.26	2.89	1.76	1.55		0.00	9.84	1.07	0.13	1.79	0.41	2.70		106.10	25.04
SAN-037	0.72	0.18	3.22	1.98	0.34		7.14	4.19	1.73	0.00	2.52	1.74	1.83		6.34	5.81	0.65	0.00	1.17	0.45	1.28		59.59	24.31
SAN-045	0.66	0.20	2.58	0.83	0.05		5.15	2.63	1.73	0.00	2.98	1.98	2.60		15.55	7.68	0.63	0.02	1.28	0.40	2.12		67.04	22.83
(Hole III)																								
SAN-023	1.16	1.01	2.75	3.91	0.71		0.84	9.64	1.88	0.85	3.22	5.05	0.79		4.80	20.16	2.47	0.51	5.22	4.12	5.30		39.06	117.94
SAN-030	0.84	0.85	4.13	2.11	0.58		1.96	2.48	1.87	0.82	4.04	6.14	1.28		0.90	10.43	1.11	0.04	1.85	7.53	2.20		101.68	24.50
SAN-038	1.01	0.73	5.12	4.01	0.32		1.15	2.34	1.67	0.54	3.82	4.15	1.94		0.00	10.98	0.88	0.13	1.32	7.52	1.73		99.14	16.17
SAN-046	0.73	0.58	5.55	3.47	0.28		1.13	3.55	1.50	0.35	3.27	3.55	2.15		2.97	9.08	0.57	0.65	1.19	5.88	1.54		105.60	17.74
SAN94-024	0.72	0.64	4.85	3.11	0.46		1.35	3.71	2.45	0.47	5.01	2.19	3.71		0.00	3.71	0.89	0.00	3.70	0.00	3.47		380.59	18.45
SAN94-028	0.84	0.00	1.95	3.19	0.58		0.32	4.41	1.88	0.54	5.83	2.19	2.11		3.57	4.41	0.92	0.00	4.76	0.00	3.34		398.46	23.05
(Hole IV)																								
SAN-024	0.70	0.27	3.63	4.36	0.09		2.95	20.49	1.76	0.39	6.55	2.38	1.07		2.03	23.67	1.77	0.31	9.79	2.22	6.41		46.50	83.42
SAN-031	0.54	0.26	2.52	1.38	0.16		0.70	2.88	2.52	0.21	6.67	1.86	0.77		4.90	11.44	1.89	0.43	3.22	1.54	4.03		55.38	36.80
SAN-039	0.17	0.20	2.92	2.77	0.15		1.78	1.59	2.14	0.12	2.46	2.33	1.66		11.30	8.81	0.42	0.69	0.53	0.93	1.67		98.92	12.83
SAN-047	0.51	0.20	3.00	2.38	0.05		2.12	2.96	1.83	0.24	0.81	0.92	1.75		6.25	6.25	0.25	0.70	0.53	1.44	1.56		82.03	6.80
SAN94-044	1.03	0.24	3.89	2.32	0.66		4.74	3.40	1.73	0.78	3.61	2.57	2.45		0.00	3.41	0.85	0.00	0.77	0.00	3.34		366.29	17.86
SAN94-049	0.40	0.00	4.54	2.93	0.55		0.47	1.48	1.47	0.96	11.21	2.06	3.19		7.39	1.49	1.82	0.00	6.29	0.00	4.24		688.36	21.60
(Hole V)																								
SAN-025	1.06	0.66	6.11	4.74	0.55		1.51	17.69	1.26	0.62	8.91	3.56	1.43		5.11	19.05	1.52	0.06	10.13	2.75	6.69		54.38	75.16
SAN-032	0.92	0.68	4.75	3.86	0.43		2.02	3.90	1.24	0.24	5.11	3.56	1.72		7.24	8.68	0.71	0.00	0.85	2.70	1.69		88.63	7.10
SAN-040	0.39	0.57	4.96	5.06	0.41		2.68	2.29	1.24	0.82	3.29	2.35	1.84		12.45	5.66	0.59	0.13	0.55	2.80	1.22		92.84	5.35
SAN-048	0.79	1.02	5.31	3.57	0.43		1.01	4.00	0.69	0.72	3.26	4.12	1.73		23.58	6.70	0.41	0.02	0.63	2.36	1.07		87.89	6.20
(Hole VI)																								
SAN-027	0.79	0.70	2.91	3.35	0.32		3.75	3.71	1.45	1.24	2.84	2.33	0.88		2.31	15.13	3.12	0.36	6.27	2.46	5.02		39.09	101.79
SAN-033	0.62	0.50	3.80	3.57	0.52		5.88	1.26	1.83	0.57	2.68	3.10	2.31		0.18	10.79	1.39	0.00	1.08	2.04	3.04		120.36	24.31
SAN-041	0.44	0.41	3.25	3.04	0.39		5.09	2.19	1.45	0.21	2.22	3.21	1.71		0.00	8.54	0.63	0.00	0.95	2.65	1.35		100.87	10.52
SAN-049	0.44	0.20	2.88	2.88	0.67		4.29	1.23	1.95	0.66	2.70	3.13	1.74		0.53	8.49	0.58	0.00	0.95	1.69	1.46		99.15	11.64
SAN94-017	0.34	0.12	4.27	3.32	0.39		4.09	3.64	1.52	0.53	4.20	3.61	2.93		13.95	3.65	0.81	0.00	1.22	0.00	2.49		370.91	14.90
SAN94-023	0.81	0.27	4.26	3.28	0.44		2.93	3.57	1.47	0.00	5.04	2.09	3.36		5.61	3.57	0.67	0.00	2.06	0.00	3.18		389.62	19.28

(Hole VII)																									
Bedrock																									
SAN-035	1.51	1.18	7.54	7.88	1.22		4.58	3.11	1.86	1.49	8.86	7.30	6.44		39.22	9.87	0.92	0.36	3.39	5.97	5.73		169.16	11.27
SAN-043	1.51	0.91	8.04	6.71	1.00		4.28	4.20	1.40	1.19	7.72	7.40	2.62		33.32	6.07	0.57	0.25	2.72	7.53	1.95		88.79	8.88
SAN-052	1.35	0.84	6.76	4.47	0.82		1.32	2.50	2.06	1.02	6.50	5.13	1.95		21.90	7.29	1.57	0.04	2.12	4.05	1.97		158.25	5.76
Bedrock with fractures																									
SAN-026	1.73	1.12	6.85	5.59	0.96		0.34	1.11	2.04	1.25	7.52	7.55	3.55		7.24	11.82	1.17	0.53	2.80	7.13	5.31		127.50	16.36
SAN-034	0.95	0.73	5.59	2.52	0.16		1.32	3.61	2.37	0.60	8.45	7.53	1.65		25.44	13.96	2.36	0.25	2.20	7.00	4.20		211.89	17.03
SAN-042	1.39	0.84	6.23	4.72	0.79		3.51	4.01	2.47	1.10	6.41	5.76	1.91		12.13	8.69	1.82	0.08	4.87	4.03	3.78		179.35	13.00
SAN-050	1.27	0.81	6.50	5.25	0.78		2.48	4.63	2.36	1.17	4.89	5.23	1.98		24.62	5.96	0.94	0.04	1.31	4.47	1.55		95.53	6.81
SAN-051	1.43	1.14	5.33	7.38	1.35		1.74	4.67	2.66	1.62	5.20	6.80	2.12		6.62	8.24	2.90	0.40	3.23	6.97	4.99		106.90	25.15
Outside delta 3 near SE corner																									
SAN94-008	0.73	0.15	3.39	3.59	0.52		4.67	2.45	1.47	0.67	3.81	2.19	2.14		2.62	2.45	0.90	0.00	1.53	0.00	2.97		289.33	21.79
SAN94-010	0.65	0.14	3.77	3.73	0.50		0.00	3.82	1.11	0.76	3.30	2.91	2.14		11.20	3.82	0.50	0.00	1.35	0.00	2.31		489.47	15.92
SAN94-016	0.91	0.00	4.24	2.57	0.42		6.13	2.13	1.20	0.53	12.99	2.43	2.10		43.56	2.13	0.72	0.00	5.86	0.00	2.91		441.25	13.92
South of hole III																									
SAN94-029	0.20	0.09	4.39	3.20	0.70		4.74	19.74	1.16	0.51	6.95	3.00	1.55		0.00	19.74	3.42	0.00	14.13	0.84	10.36		661.91	143.57
SAN94-031	0.51	0.00	4.67	2.30	0.58		4.78	2.84	1.62	0.37	8.88	3.12	1.72		0.00	2.84	1.26	0.00	4.85	0.00	4.73		391.44	30.13
SAN94-032	1.18	0.00	3.90	2.93	0.49		6.35	5.20	0.98	0.71	4.40	2.18	1.95		15.18	5.21	0.85	0.00	1.70	0.00	3.37		384.95	14.90
SAN94-037	0.37	0.00	4.88	3.52	0.42		4.18	1.95	1.92	0.48	11.62	2.83	2.59		9.81	1.95	0.83	0.00	5.74	0.00	2.59		373.72	18.22
Packed earth between holes IV and V																									
SAN94-043	1.27	0.22	2.46	3.18	0.61		5.12	6.41	2.28	0.43	4.45	0.70	0.56		1.33	6.41	5.46	0.00	10.63	0.86	6.05		200.25	158.37
Base Chemistry																									
SAN-053	0.86	0.67	8.62	2.00	0.76		5.17	5.04	1.13	0.65	6.26	1.87	2.64		14.52	9.42	0.84	0.55	2.49	2.29	2.69		174.29	11.59
Lithic rich tuff																									
SAN94-039A	0.57	0.55	5.26	2.23	0.68		0.52	5.13	1.22	0.51	37.63	2.68	1.77		63.53	5.13	0.00	0.00	6.37	0.00	2.42		510.55	13.39
SAN94-039B	0.30	0.13	3.47	3.66	0.40		0.86	6.04	1.18	0.44	35.12	2.35	3.44		77.39	6.04	0.00	0.00	4.14	0.00	4.46		547.98	11.24
Weathered lithic tuff																									
SAN94-038	0.13	0.00	4.31	2.17	0.81		0.86	5.12	0.88	0.54	6.52	1.90	2.51		97.02	5.12	0.78	0.00	3.21	0.00	4.62		896.93	31.95
Ash grains and corrosion products from artifact (tong) in delta 18a																									
SAN94-051	20.40	0.82	19.68	6.51	1.89		4.27	18.64	3274.85	1.82	75.73	5.82	13.41		521.17	18.64	5874.77	0.00	42.92	0.00	12.05		6016.74	74.37

11/23/94 gp Transferred sample powders of plants from 7cm PP vials to 1.5 inch diameter PP containers. Weight transferred is recorded below:

	wt. container	wt container + plant	wt plant
	4.3798		
FR-A-1-G	~~4.4220~~ gp 11/23	6.0940	1.7142
FR-A-3-G	4.4219	6.3160	1.8941
FR-A-4-G	4.3903	5.6230	1.2327
.			
FR-B-1-G	4.4204	5.0741	.6537
FR-B-2-G	4.3532	5.6587	1.3055
FR-B-3-G	4.3748	5.1792	.8044
FR-B-4-G	4.4202	5.5263	1.1061

Containers were sealed with silicone rubber to allow equilibration with R_W. (3 weeks).

12/12/94 gp Santorini leaching

Samples of SAN-023, SAN-038, and SAN-046 were placed in 50 ml centrifuge tubes + labeled as below:

	wt tube	wt tube + powder	wt powder
SAN-023-A-WRI	13.754	14.779	1.025
" B	13.672	14.686	1.014
" C	13.671	14.706	1.035
" D	13.644	14.667	1.023
SAN-038-A-WRI	13.797	14.838	1.041
" B	13.742	14.766	1.024
" C	13.830	14.852	1.022
" D	13.741	14.776	1.035
SAN-046-A-WRI	13.671	14.686	1.015
" B	13.668	14.689	1.021
" C	13.709	14.723	1.014
" D	13.763	14.779	1.016

Samples were leached + analyzed using procedure on pp 245-247.

12/12/94 gp Santa Ana leach

Samples of SAN-024, SAN-039, and SAN-047 were placed in 50 ml centrifuge Tubes and labeled as below:

		wt tube	wt tube + powder	wt powder
SAN-024-A (WRI)		13.686	14.716	1.030
"	B	13.662	14.698	1.036
"	C	13.701	14.725	1.024
"	D	13.837	14.868	1.031
SAN-039-A (WRI)		13.772	14.803	1.031
"	B	13.809	14.833	1.024
"	C	13.772	14.805	1.033
"	D	13.946	14.973	1.027
SAN-047-A (WRI)		13.777	14.818	1.041
"	B	13.730	14.760	1.030
"	C	13.690	14.711	1.021
"	D	13.743	14.765	1.022

Samples were leached + analyzed using procedure on p 245-247.

12/12/94 gp Santa Ana leach

Samples SAN-041, SAN-049, and SAN94-050 were placed in 50 ml centrifuge tubes and labeled as below:

		wt Tube	wt Tube + powder	wt powder
SAN-041-A (WRI)		13.747	14.771	1.024
"	B	13.713	14.730	1.017
"	C	13.646	14.669	1.023
"	D	13.850	14.878	1.028
SAN-049-A (WRI)		13.739	14.774	1.035
"	B	13.794	14.815	1.021
"	C	13.653	14.666	1.013
"	D	13.780	14.797	1.017
SAN94-050-A (WRI)		13.718	14.225	12/14/94 gp .507
"	B	13.812	14.314	.502
"	C	13.725	14.243	.518
"	D	13.783	14.286	.503

Samples were leached + analyzed using procedure on p 245-247

12/13/94 gp XRD of Santorini powders

Powders of SAN94-050-WR1 and SAN94-051-WR1 were prepared and analyzed by XRD.

Powders were placed in front mounty glass holders. XRD analysis was prepared in DIN 01 mi Siemen D5000 x-ray diffractometer + JADE software for data analysis.

Results are kept in 3 ring binder entitled "XRD Analyses, Santorini, Greece".

Samples labels were
SAN94-050-XRD1
SAN94-051-XRD1

After analysis powders were returned to whole rock sample containers.

12/15/94 gp $NH_2OH \cdot HCl$ leach step wts.

Sample	wt after 10ml reagent added	wt after leach	wt reagent lost
SAN-023-WR1-A	25.62	25.56	0.06
" B	25.56	25.46	0.10
" C	25.61	25.53	0.08
" D	25.51	25.41	0.10
SAN-038-WR1-A	25.45	25.16	0.29
" B	25.41	~~25.11~~ 24.44 gp 12/15/94	0.97
" C	25.55	24.53	1.02
" D	25.49	24.90	0.59
SAN-046-WR1-A	25.45	24.52	0.93
" B	25.42	24.76	0.66
" C	25.45	24.80	0.65
" D	25.40	25.30	0.10
SAN-024-WR1-A	25.29	24.90	0.39
" B	25.33	24.77	0.56
" C	25.28	25.21	0.07
" D	25.40	25.31	0.09
SAN-039-WR1-A	25.33	25.19	0.14
" B	25.37	25.10	0.27
" C	24.93	24.81	0.12
" D	25.39	25.27	0.12
SAN-047-WR1-A	25.41	25.15	0.26
" B	25.39	24.87	0.52
" C	25.23	24.89	0.34
" D	25.33	24.86	0.47

12/16/94 gp $NH_2OH \cdot HCl$ leach step wts.

Sample	wt after 10ml weight added	wt after leach	wt weight lost.
SAN-041-WRI-A	25.27	25.16	0.11
" B	25.33	25.20	0.13
" C	24.87	24.79	0.08
" D	25.35	25.22	0.13
SAN-049-WRI-A	25.36	25.22	0.14
" B	25.47	25.37	0.10
" C	25.23	25.17	0.06
" D	25.41	25.33	0.08
SAN94-050-WRI-A	24.76	24.42	0.24
" B	24.91	24.17	0.74
" C	24.70	24.02	0.68
" D	24.87	24.68	0.19
SAN94-044-WRI-A1	25.54	25.48	0.06
" B1	25.34	24.80	0.54
" C1	25.37	25.26	0.11
" D1	25.21	25.09	0.12
SAN94-044-WRI-A2	25.45	25.37	0.08
" B2	25.16	24.81	0.35
" C2	25.35	25.29	0.06
" D2	25.30	25.20	0.10
SAN94-017-WRI-A1	25.32	25.24	0.08
" B1	25.07	24.97	0.10
" C1	25.43	25.43	0.00
" D1	24.91	24.81	0.10

12/14/94 gp Sartorini leaching

Samples of SAN94-044-WRI-A1 and SAN94-017-WRI were placed in 50 ml centrifuge tubes + labeled as below:

	wt tube	wt tube + powder	wt powder
SAN94-044-WRI-A1	13.921	14.961	1.040
" B1	13.792	14.813	1.021
" C1	13.659	14.697	1.038
" D1	13.604	14.621	1.017
SAN94-044-WRI-A2	13.704	14.737	1.033
" B2	13.630	14.662	1.032
" C2	13.674	14.699	1.025
" D2	13.781	14.790	1.009
SAN94-017-WRI-A1	13.776	14.817	1.041
" B1	13.671	14.703	1.032
" C1	13.861	14.869	1.008
" D1	13.607	14.626	1.019

Samples were leached + analyzed using procedure on pp 245-247.

12/20/94 JP Results of leaching experiments up to this point.

Santorini Leaching Results

SAMPLE NO.	MgCl2 exchangeable								Carbonate fraction								Fe-Mn oxides							
	Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn	Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn	Cu	Ag	Co	Pb	Zn	Sn	Fe	Mn
Profiles																								
(Hole I)																								
SAN-021	1.05	0.94	4.87	5.91	0.57		5.50	5.67	1.49	1.50	5.30	4.71	1.36		0.00	13.55	2.12	0.00	7.15	5.52	4.13		62.09	83.32
SAN-028	1.24	0.83	4.25	5.41	0.55		1.13	4.25	2.99	0.70	4.84	4.75	1.17		0.00	15.82	1.86	0.00	2.45	4.52	3.27		127.45	34.45
SAN-036	1.11	0.83	6.19	6.47	0.59		1.52	3.75	1.83	0.84	4.79	3.88	1.76		8.43	8.32	0.70	0.00	1.91	4.49	1.62		121.81	13.43
SAN-044	0.74	0.97	4.76	4.94	0.52		3.63	4.53	1.53	0.82	5.03	4.69	1.76		9.86	7.28	0.65	0.15	1.67	4.67	1.51		74.87	10.55
(Hole II)																								
SAN-022	0.68	0.47	4.48	1.06	0.37		2.68	11.67	1.27	0.65	5.86	1.94	1.38		0.00	18.48	1.43	0.19	8.91	0.63	5.92		61.80	125.71
SAN-022*	1.06	1.48	3.90	3.89	0.86		0.00	11.74	1.01	0.15	2.61	0.15	1.67		0.00	17.91	3.53	0.00	11.40	0.44	9.58		654.60	154.60
SAN-029	1.02	0.66	4.19	2.88	0.27		2.99	5.62	1.60	0.26	2.89	1.76	1.55		0.00	9.84	1.07	0.13	1.79	0.41	2.70		106.10	25.04
SAN-037	0.72	0.18	3.22	1.98	0.34		7.14	4.19	1.73	0.00	2.52	1.74	1.83		6.34	5.81	0.65	0.00	1.17	0.45	1.28		59.59	24.31
SAN-045	0.66	0.20	2.58	0.83	0.05		5.15	2.63	1.73	0.00	2.98	1.98	2.60		15.55	7.68	0.63	0.02	1.28	0.40	2.12		67.04	22.83
(Hole III)																								
SAN-023	1.16	1.01	2.75	3.91	0.71		0.84	9.64	1.88	0.85	3.22	5.05	0.79		4.80	20.16	2.47	0.51	5.22	4.12	5.30		39.06	117.94
SAN-023*	1.12				0.90		1.62	4.88	2.13				1.13		0.00	19.86	6.45				11.16		642.50	136.35
SAN-030	0.84	0.85	4.13	2.11	0.58		1.96	2.48	1.87	0.82	4.04	6.14	1.28		0.90	10.43	1.11	0.04	1.85	7.53	2.20		101.68	24.50
SAN-030*	0.99	0.00	4.10	4.61	0.95		3.70	1.28	1.83	0.36	2.03	1.30	1.49		0.00	8.56	0.93	0.00	1.10	2.65	2.92		386.81	34.34
SAN-038	1.01	0.73	5.12	4.01	0.32		1.15	2.34	1.67	0.54	3.82	4.15	1.94		0.00	10.98	0.88	0.13	1.32	7.52	1.73		99.14	16.17
SAN-038*	1.23				0.93		1.12	2.38	1.83				2.09		2.35	10.56	0.51				2.84		337.07	25.27
SAN-046	0.73	0.58	5.55	3.47	0.28		1.13	3.55	1.50	0.35	3.27	3.55	2.15		2.97	9.08	0.57	0.65	1.19	5.88	1.54		105.60	17.74
SAN-046*	0.91				1.14		0.00	2.24	1.95				2.19		10.26	6.15	0.71				2.76		308.51	21.37
SAN94-024	0.72	0.64	4.85	3.11	0.46		1.35	3.71	2.45	0.47	5.01	2.19	3.71		0.00	9.39	0.89	0.00	3.70	0.00	3.47		380.59	18.45
SAN94-025	0.52	0.00	6.66	3.95	0.55		0.00	3.51	1.44	0.61	4.59	1.58	2.23		5.14	9.44	0.28	0.00	1.41	1.78	2.57		459.58	19.46
SAN94-026	0.42	0.83	5.63	3.33	0.67		0.00	3.55	1.79	0.00	2.67	1.85	1.67		1.58	7.80	0.68	0.00	1.91	0.00	2.70		513.37	27.92
SAN94-028	0.84	0.00	1.95	3.19	0.58		0.32	4.41	1.88	0.54	5.83	2.19	2.11		3.57	6.36	0.92	0.00	4.76	0.00	3.34		398.46	23.05
(Hole IV)																								
SAN-024	0.70	0.27	3.63	4.36	0.09		2.95	20.49	1.76	0.39	6.55	2.38	1.07		2.03	23.67	1.77	0.31	9.79	2.22	6.41		46.50	83.42
SAN-024*	1.12				1.46		2.07	9.39	1.65				1.47		0.00	21.31	3.51				9.38		561.00	110.27
SAN-031	0.54	0.26	2.52	1.38	0.16		0.70	2.88	2.52	0.21	6.67	1.86	0.77		4.90	11.44	1.89	0.43	3.22	1.54	4.03		55.38	36.80
SAN-031*	0.57	0.00	3.92	4.85	0.88		0.00	4.57	1.55	0.15	5.07	0.66	0.91		0.00	11.39	2.08	0.00	5.91	0.00	5.75		233.55	45.58
SAN-039	0.17	0.20	2.92	2.77	0.15		1.78	1.59	2.14	0.12	2.46	2.33	1.66		11.30	8.81	0.42	0.69	0.53	0.93	1.67		98.92	12.83
SAN-039*	0.73				0.86		0.00	2.95	1.46				1.97		11.22	7.92	0.46				3.07		321.81	20.70
SAN-047	0.51	0.20	3.00	2.38	0.05		2.12	2.96	1.83	0.24	0.81	0.92	1.75		6.25	6.25	0.25	0.70	0.53	1.44	1.56		82.03	6.80
SAN-047*	0.70				0.73		1.96	3.84	1.28				2.47		9.01	5.41	0.53				2.82		308.87	19.87
SAN94-044	1.03	0.24	3.89	2.32	0.66		4.74	3.40	1.73	0.78	3.61	2.57	2.45		0.00	8.62	0.85	0.00	0.77	0.00	3.34		366.29	17.86
SAN94-044-1	0.98				0.64		1.10	2.38	1.88				2.83		2.97	8.71	0.86				3.31		326.67	22.02
SAN94-044-2	1.03				1.01		1.29	2.41	1.72				2.88		3.78	8.63	0.77				3.64		299.56	24.55
SAN94-045	0.88	1.41	7.32	3.93	1.00		1.83	1.97	1.25	0.00	6.45	0.66	1.89		8.40	8.46	0.62	0.00	1.92	0.00	2.73		376.47	16.30
SAN94-046	1.06	0.00	5.61	3.80	0.76		1.43	2.69	1.27	0.00	2.12	0.86	1.74		4.15	4.44	0.51	0.00	0.99	0.00	2.37		326.44	13.74
SAN94-047	0.96	1.26	6.06	4.64	0.69		2.16	2.39	1.21	1.36	2.41	0.98	1.56		12.38	4.93	0.56	0.00	1.03	0.00	2.00		536.84	15.69
SAN94-049	0.40	0.00	4.54	2.93	0.55		0.47	1.48	1.47	0.96	11.21	2.06	3.19		7.39	7.94	1.82	0.00	6.29	0.00	4.24		688.36	21.60
(Hole V)																								
SAN-025	1.06	0.66	6.11	4.74	0.55		1.51	17.69	1.26	0.62	8.91	3.56	1.43		5.11	19.05	1.52	0.06	10.13	2.75	6.69		54.38	75.16
SAN-032	0.92	0.68	4.75	3.86	0.43		2.02	3.90	1.24	0.24	5.11	3.56	1.72		7.24	8.68	0.71	0.00	0.85	2.70	1.69		88.63	7.10
SAN-040	0.39	0.57	4.96	5.06	0.41		2.68	2.29	1.24	0.82	3.29	2.35	1.84		12.45	5.66	0.59	0.13	0.55	2.80	1.22		92.84	5.35
SAN-048	0.79	1.02	5.31	3.57	0.43		1.01	4.00	0.69	0.72	3.26	4.12	1.73		23.58	6.70	0.41	0.02	0.63	2.36	1.07		87.89	6.20

(Hole VI)																							
SAN-027	0.79	0.70	2.91	3.35	0.32		3.75	3.71	1.45	1.24	2.84	2.33	0.88		2.31	15.13	3.12	0.36	6.27	2.46	5.02		39.09	101.79
SAN-027*	1.38	5.98	3.45	3.94	1.00		2.22	2.98	2.04	0.35	2.43	1.36	0.80		0.00	14.26	5.59	0.00	7.32	0.00	8.64		431.92	119.42
SAN-033	0.62	0.50	3.80	3.57	0.52		5.88	1.26	1.83	0.57	2.68	3.10	2.31		0.18	10.79	1.39	0.00	1.08	2.04	3.04		120.36	24.31
SAN-033*	0.57	0.79	3.73	4.69	0.85		0.36	2.00	1.52	0.00	2.62	0.00	1.65		0.00	6.89	1.08	0.00	1.87	0.31	3.47		407.90	33.99
SAN-041	0.44	0.41	3.25	3.04	0.39		5.09	2.19	1.45	0.21	2.22	3.21	1.71		0.00	8.54	0.63	0.00	0.95	2.65	1.35		100.87	10.52
SAN-041*	0.94				0.89		0.33	3.21	2.05				2.21		5.27	6.38	0.83				2.89		345.61	18.71
SAN-049	0.44	0.20	2.88	2.88	0.67		4.29	1.23	1.95	0.66	2.70	3.13	1.74		0.53	8.49	0.58	0.00	0.95	1.69	1.46		99.15	11.64
SAN-049*	0.93				0.84		0.00	3.53	2.13				2.23		9.15	6.59	0.97				3.15		294.31	21.21
SAN94-017	0.34	0.12	4.27	3.32	0.39		4.09	3.64	1.52	0.53	4.20	3.61	2.93		13.95	5.36	0.81	0.00	1.22	0.00	2.49		370.91	14.90
SAN94-017-1	0.78				0.65		0.80	2.68	1.93				2.47		12.55	6.79	0.72				3.42		391.99	21.36
SAN94-018	0.29	0.00	5.48	3.17	0.75		0.00	3.44	1.76	0.21	3.08	1.30	2.19		10.94	8.63	0.68	0.00	0.98	0.00	2.39		247.98	21.72
SAN94-020	0.67	0.00	5.25	3.73	0.55		0.00	2.94	2.18	0.67	3.10	1.81	3.26		14.52	10.23	0.38	0.00	0.92	0.00	2.46		272.54	16.32
SAN94-021	0.62	0.43	5.77	3.50	0.78		0.00	3.33	1.68	0.43	3.10	1.26	2.05		8.87	7.14	0.44	0.00	1.23	0.18	2.55		357.34	20.71
SAN94-023	0.81	0.27	4.26	3.28	0.44		2.93	3.57	1.47	0.00	5.04	2.09	3.36		5.61	8.91	0.67	0.00	2.06	0.00	3.18		389.62	19.28
(Hole VII)																							
Bedrock																							
SAN-035	1.51	1.18	7.54	7.88	1.22		4.58	3.11	1.86	1.49	8.86	7.30	6.44		39.22	9.87	0.92	0.36	3.39	5.97	5.73		169.16	11.27
SAN-043	1.51	0.91	8.04	6.71	1.00		4.28	4.20	1.40	1.19	7.72	7.40	2.62		33.32	6.07	0.57	0.25	2.72	7.53	1.95		88.79	8.88
SAN-052	1.35	0.84	6.76	4.47	0.82		1.32	2.50	2.06	1.02	6.50	5.13	1.95		21.90	7.29	1.57	0.04	2.12	4.05	1.97		158.25	5.76
Bedrock with																							
fractures																							
SAN-026	1.73	1.12	6.85	5.59	0.96		0.34	1.11	2.04	1.25	7.52	7.55	3.55		7.24	11.82	1.17	0.53	2.80	7.13	5.31		127.50	16.36
SAN-034	0.95	0.73	5.59	2.52	0.16		1.32	3.61	2.37	0.60	8.45	7.53	1.65		25.44	13.96	2.36	0.25	2.20	7.00	4.20		211.89	17.03
SAN-042	1.39	0.84	6.23	4.72	0.79		3.51	4.01	2.47	1.10	6.41	5.76	1.91		12.13	8.69	1.82	0.08	4.87	4.03	3.78		179.35	13.00
SAN-050	1.27	0.81	6.50	5.25	0.78		2.48	4.63	2.36	1.17	4.89	5.23	1.98		24.62	5.96	0.94	0.04	1.31	4.47	1.55		95.53	6.81
SAN-051	1.43	1.14	5.33	7.38	1.35		1.74	4.67	2.66	1.62	5.20	6.80	2.12		6.62	8.24	2.90	0.40	3.23	6.97	4.99		106.90	25.15
Outside delta 3																							
near SE corner																							
SAN94-008	0.73	0.15	3.39	3.59	0.52		4.67	2.45	1.47	0.67	3.81	2.19	2.14		2.62	9.32	0.90	0.00	1.53	0.00	2.97		289.33	21.79
SAN94-010	0.65	0.14	3.77	3.73	0.50		0.00	3.82	1.11	0.76	3.30	2.91	2.14		11.20	9.13	0.50	0.00	1.35	0.00	2.31		489.47	15.92
SAN94-012	0.69	0.04	6.24	3.38	0.60		0.00	2.63	1.67	0.26	4.50	1.14	3.81		32.55	8.89	0.39	0.00	1.67	0.30	4.09		333.23	14.93
SAN94-014	0.67	0.00	6.84	3.72	0.76		0.56	3.46	1.18	0.71	3.90	0.53	1.85		30.93	8.48	0.33	0.00	1.96	0.00	2.53		496.95	17.77
SAN94-016	0.91	0.00	4.24	2.57	0.42		6.13	2.13	1.20	0.53	12.99	2.43	2.10		43.56	8.17	0.72	0.00	5.86	0.00	2.91		441.25	13.92
South of hole III																							
SAN94-029	0.20	0.09	4.39	3.20	0.70		4.74	19.74	1.16	0.51	6.95	3.00	1.55		0.00	20.68	3.42	0.00	14.13	0.84	10.36		661.91	143.57
SAN94-031	0.51	0.00	4.67	2.30	0.58		4.78	2.84	1.62	0.37	8.88	3.12	1.72		0.00	9.42	1.26	0.00	4.85	0.00	4.73		391.44	30.13
SAN94-032	1.18	0.00	3.90	2.93	0.49		6.35	5.20	0.98	0.71	4.40	2.18	1.95		15.18	6.90	0.85	0.00	1.70	0.00	3.37		384.95	14.90
SAN94-033	0.71	1.17	5.75	3.21	0.73		0.90	3.66	1.27	0.85	2.88	0.81	1.67		11.88	5.05	0.57	0.00	1.01	0.00	2.26		309.61	15.14
SAN94-034	0.69	1.74	5.82	3.61	0.84		0.00	1.67	1.20	0.51	3.18	1.76	1.42		11.67	5.08	0.65	0.00	1.76	0.39	2.34		458.71	22.18
SAN94-036	0.96	0.94	6.85	3.41	0.88		1.09	2.32	1.15	0.42	3.76	0.06	1.49		11.25	4.96	0.40	0.00	0.94	0.00	1.93		257.72	17.08
SAN94-037	0.37	0.00	4.88	3.52	0.42		4.18	1.95	1.92	0.48	11.62	2.83	2.59		9.81	6.42	0.83	0.00	5.74	0.00	2.59		373.72	18.22
Packed earth																							
between holes																							
IV and V																							
SAN94-043	1.27	0.22	2.46	3.18	0.61		5.12	6.41	2.28	0.43	4.45	0.70	0.56		1.33	13.86	5.46	0.00	10.63	0.86	6.05		200.25	158.37

Santorini Leaching Results

Base Chemistry																								
SAN-053	0.86	0.67	8.62	2.00	0.76		5.17	5.04	1.13	0.65	6.26	1.87	2.64		14.52	9.42	0.84	0.55	2.49	2.29	2.69		174.29	11.59
Lithic rich tuff																								
SAN94-039A	0.57	0.55	5.26	2.23	0.68		0.52	5.13	1.22	0.51	37.63	2.68	1.77		63.53	7.71	0.00	0.00	6.37	0.00	2.42		510.55	13.39
SAN94-039B	0.30	0.13	3.47	3.66	0.40		0.86	6.04	1.18	0.44	35.12	2.35	3.44		77.39	8.34	0.00	0.00	4.14	0.00	4.46		547.98	11.24
Weathered lithic tuff																								
SAN94-038	0.13	0.00	4.31	2.17	0.81		0.86	5.12	0.88	0.54	6.52	1.90	2.51		97.02	7.15	0.78	0.00	3.21	0.00	4.62		896.93	31.95
Ash grains and corrosion products from artifact (tong) in delta 18a																								
SAN94-051	20.40	0.82	19.68	6.51	1.89		4.27	18.64	3274.85	1.82	75.73	5.82	13.41		521.17	118.92	5874.77	0.00	42.92	0.00	12.05		6016.74	74.37
Corrosion products from saw blade																								
SAN94-050	745.61				3.05		5.01	20.79	73800.20				44.67		21.30	247.38	39207.05				53.00		1968.57	80.64

Page 3

12/20/94 gp Petrographic analyses were conducted on thin sections of samples from the major 13m N fracture on the +10 level of Nopal I.

The Nikon Optiphot-Pol petrographic microscope and camera attachment were used to do the analyses.

Descriptions and photos are kept in a 3 ring binder entitled "Analyses of Fe-oxide bearing Fractures at Nopal I, Chihuahua, Mexico."

12/21/94 DAP (David Pickett)

New γ-spec Analysis of Nopal Plants

Have taken remaining portion of FR-A plant sample and placed on tray in oven at 100°C for 24 hours. (Was previously dried, so this is just to remove adsorbed water.) See 080/35,36,40. These are the washed plants.

Transfer portions to 50 ml porcelain crucibles.
5+6: roughly equivalent mixtures of leaves and stems. An attempt at "whole plant" replicates.
7: leaves only
8: stems only.

FR-A-5		FR-A-6
31.9045 g	wt. empty crucible	32.6747 g
44.4274	plus dried plant	44.2679
33.5166	after ashing	34.1662

FR-A-7		FR-A-8
30.2884	wt. empty crucible	32.7405
40.5970	plus dried plant	42.5492
31.6934	after ashing	33.9185

After weighing dried plant into crucibles, place crucibles in muffle furnace and set to low, 11:00 a.m.
Front crucible = 5, rear = 8.
12:00 noon. Too much smoke. Turn off ~~oven~~ DAP 12/21 furnace.
Place furnace in hood, 12:20 pm, resume ashing.
3:00 pm: temp. has risen to 360°C with control setting still at "low." Raise to "1."
3:55 - 450° C
5:00 - 480°. Turn back to "low".
7:30 pm - 380°. Turn off.

12/22/94 DAP

Remove plant ash samples from muffle furnace and weigh crucible + ash. Recorded on p. 290.
Grind each in its crucible and transfer to 37 mm-diameter vials.

	FR-A-5	FR-A-6	FR-A-7	FR-A-8
vial + ash	5.9915	5.8672	5.8017	5.5170
empty vial	4.3838	4.3829	4.4069	4.3496
	1.6077 g	1.4843 g	1.3948 g	1.1674 g

Seal all vials with clear silicone.

Calculate correction factors to translate γ data to dried plant. (Remember: wt. ash in vial is not = total. Some lost.)

FR-A-5 $\frac{\text{dried}}{\text{ash}} = \frac{44.4274 - 31.9045}{33.5166 - 31.9045} = \frac{12.5229}{1.6121}$ g/g

$= 7.7681$

$\frac{\text{ash}}{\text{dried}} = 0.1287 \rightarrow$ multiply by ash Bq/g to get dried plant Bq/g

FR-A-6 $\frac{\text{ash}}{\text{dried}} = \frac{\cancel{34.1662}}{\cancel{32.6747}}$ DAP 12/22/94
$= \frac{34.1662 - 32.6747}{44.2679 - 32.6747} = \frac{1.4915}{11.5932}$ g/g

$= 0.1287$

FR-A-7 $\frac{\text{ash}}{\text{dried}} = \frac{31.6934 - 30.2884}{40.5970 - 30.2884} = \frac{1.4050}{10.3086}$ g/g

$= 0.1363$

FR-A-8 $\frac{\text{ash}}{\text{dried}} = \frac{33.9185 - 32.7405}{42.5492 - 32.7405} = \frac{1.1780}{9.8087}$ g/g

$= 0.1201$

1/11/95 DAP

Began gamma spectrometric measurements of FR-A-5 thru 8. Enough time has passed to ensure Rn daughter equilibrium.

1/18/95 DAP

Notes on CCL calculations for ash/dried wts. on page 40 of this notebook.

① FR-B-2 calculated "mass change" is wrong. Should be 10.53 g.

② In some cases, calculated weight of ash placed in gamma spec. vials is greater than weight calculated on basis of difference between "wt. cruc. + sample after ashing" on p. 40 and "wt. crucible" on p. 36.

FR-B-1 wt. in vial = 0.731 g
wt. by difference = 0.648 g

FR-B-3 wt. in vial = ~~0.2~~ DAP 1/18 0.922 g
wt. by difference = 0.804 g

FR-B-4 wt. in vial = 1.204 g
wt. by difference = 1.105 g

This is not possible. Something wrong in weighings.

③ See p. 48. Note that empty crucible weights are recorded nowhere in notebook. They are on a printed worksheet in the loose-leaf notebook on P. robusta gamma spectrometry. Using these weights gives highly inconsistent ash/dried ratios, ranging from 0.15 DAP 1/18 023 to 0.34. (In contrast, see the consistency of my values on p. 291.) I suspect that the empty crucible weights are incorrect.

If assume that nearly all ash was placed in vials, can calculate ash/dried based on weights on p. 50 and p. 48, but still need empty crucible weights. No good.

If assume that suspect weights are "mass ~~after ashing~~ DAP 1/18 cruc & sample after drying (g)" on p. 48, can use final ash wts. in vial and "before drying (sic)" wts. minus purported empty crucible wts.

A DAP
FR-B-1 $\frac{\text{ash}}{\text{dried}} = \frac{1.705}{38.015 - 30.193} = 0.2180$

FR-A-2 " $= \frac{1.813}{45.330 - 32.61} = 0.1425$

FR-A-3 " $= \frac{1.895}{35.230 - 28.32} = 0.2742$

FR-A-4 " $= \frac{1.222}{37.500 - 32.651} = 0.2520$

This is not satisfactory. The γ data on samples FR-A-1,2,3,4 and FR-B-1,2,3,4 must all be considered suspect.

See next page for photocopy of loose page from notebook.

	mass of crucible + sample before ashing	mass after ashing	% change
FR - A - 1 : *crucible weight 30.193 g*	**38.015 g** 7.822	**31.993 g** 1.8	**15.8411** 76.99
FR - A - 2 : *crucible weight 32.61 g*	**45.330 g** 12.72	**34.501 g** 1.89	**23.8893** 85%
FR - A - 3 : *crucible weight 28.32 g*	**35.230 g** 6.91	**30.668 g** 2.348 g DAP	**12.9500** 66%
FR - A - 4 : *crucible weight 32.651 g*	**37.500 g** 4.85	**33.950 g** 1.299	**9.4667** 73%

See previous page. DAP 1/18/95

2/15/95 JP

XRD analysis - Nopal I samples

Portions of the following samples powders were prepared & analyzed by XRD.

NOPI-397-WR1
NOPI-399-WR1
NOPI-400-WR1
NOPI-402-WR1
NOPI-405-WR1
NOPI-407-WR1

See p 203 for procedure.

Sample labels
NOPI-397-XRD1
NOPI-399-XRD1
NOPI-400-XRD1
NOPI-402-XRD1
NOPI-405-XRD1
NOPI-407-XRD1

After analysis powders were returned to their whole rock sample containers.

3/14/95 JJP

Microprobe analyses of samples from 13.5 m N Fracture and unfractured tuff

Obj: determine U and trace element content of mineral phases along 13.5 m N Fracture and in unfractured tuff

Method: microprobe analysis using rock thin sections.

Equipment - Cameca SX-50 electron microprobe (Texas A+M Univ. - Geosciences Dept.)

Procedure:

1) Thin sections of rock specimens from the 13.5 m N fracture and unfractured tuff adjacent to U-bearing fractures were placed in the Cameca SX50 microprobe

2) Quantitative mineral composition analyses were prepared at selected spots. The following elements were analyzed for U, O, Pb, Fe, As, Ca, Na, Al, Si, K, & S using wavelength dispersive x-ray microanalysis.

3) Analyses were conducted on the following thin sections from the 13.5 m N fracture:

NOPI-418-TS1
NOPI-419-TS1
NOPI-421-TS1

Results including analytical conditions & raw data are kept in a 3 ring binder entitled "TAMU Microprobe Data, 13.5 m N Fracture"

4) Analyses will be conducted on several additional samples that were left at Texas A+M.

4/28/94 TAMU Microprobe data

Microprobe data for thin sections left at TAMU were received.

Analyses were conducted on the following thin sections from the 13.5 m N fracture

NOPI-420-TS1
NOPI-422-TS1
NOPI-423-TS1
NOPI-424-TS1
NOPI-425-TS1

In addition, traverses from U-bearing fractures into unfractured rock matrix were conducted on two thin sections:

NOPI-48-TS1
NOPI-56-TS1

Results including BSE images, analytical conditions, & raw data are kept in a 3 ring binder entitled "TAMU Microprobe Data, 13.5 m N Fracture".

8/18/95 DAP

Preparation for Nopal I Field Work

PP bottles. Clean by filling with 4:1 $H_2O : HNO_3$, letting sit for 5'-12 hrs. then fill with DI water, let sit for ≥ 6 hrs.

1 liter - 12
500 ml - 24
250 ml - 4
125 ml - 24
60 ml - 5
30 ml - 5

Probably won't take all of these.

Do same with teflon bailer.
Final swirling rinse with nanopure H_2O, three times.
Dry in oven at 70°C.

8/20/95 DAP

Test Accumet 1002 pH/mV meter

① ORP (Oxidation-Reduction Potential).
Following ASTM Method D1498-93:
a) Mix 1.1 g quinhydrone with 100 ml pH 4.00 soln. Plenty of excess quinhydrone in soln. Pour some into beaker.
T = 22.3°C mV = 269 mV (steady for ~ 1 min.)
Should be 266 mV. Good!
b) Mix 1.1 g quinhydrone with 100 ml pH 7.00 soln. Again, saturated. Note ASTM method calls for using pH 6.86 phosphate reference buffer. Pour in beaker.
T = 22.3°C mV = 95 mV
Nominal value 89 mV. Good!

② pH. Note ATC temperature probe is integrated with electrode (combination).
Do three-point calibration per Accumet 1002 instructions at pH 4.00, 7.00, and 10.00. T = 22.6°C
Electrode slope is 59.18 mV. Good.
Measure pH 9.00 buffer as unknown → pH 8.94 at 22.9°C.

For trip, put ~0.5 g quinhydrone in each of 4 60-ml bottles.

8/21/95

Empty weights of PP bottles for Field Work

Weigh on open pan balance. Bottles are numbered simply 1 to 63.

1 =	100.34 g	34 =	100.06
2 =	99.88 g	35 =	100.25
3 =	100.05	36 =	99.73
4 =	99.90	37 =	36.32
5 =	100.04	38 =	37.81
6 =	100.41	39 =	38.72
7 =	100.33	40 =	38.54
8 =	99.86	41 =	19.26
9 =	100.31	42 =	19.27
10 =	54.38	43 =	18.98
11 =	54.19	44 =	19.23
12 =	55.28	45 =	19.26
13 =	54.47	46 =	19.22
14 =	54.72	47 =	18.98
15 =	54.96	48 =	19.12
16 =	54.76	49 =	19.20
17 =	54.88	50 =	19.17
18 =	54.76	51 =	19.21
19 =	54.49	52 =	19.29
20 =	54.96	53 =	19.19
21 =	35.25	54 =	19.16
22 =	54.34	55 =	19.24
23 =	54.52	56 =	19.26
24 =	54.86	57 =	19.16
25 =	54.77	58 =	19.01
26 =	54.81	59 =	19.21
27 =	54.85	60 =	19.25
28 =	55.04	61 =	19.05 ~~19.06~~
29 =	54.87	62 =	19.00
30 =	54.97	63 =	19.01
31 =	54.78	64	
32 =	54.94	65	
33 =	54.77	66	

10/30/95 DAP

Nopal Water Samples - for TIMS work.

(TIMS = thermal ionization mass spectrometry).
Will send one BH-12 water sample and filtration blank to Prof. Larry Edwards, Univ. of Minnesota, for TIMS U-Th analysis.
Before sending, retain 1/5 for other uses (e.g. ICP).

BH12W95-05F-2

bottle + all sample	315.51	
bottle wt. (p.300)	54.81	(bottle # 26)
wt. sample	260.70 g	
wt. after removing 1/5	265.18	sent to UMn.
remaining wt.	210.37 g	(BH12W95-05F)
subsample + bottle	61.8089	(BH12W95-05F-2 DAP
bottle	11.4488	
wt. subsample	50.3501 g	

W95-Blank-F-2

bottle + all sample	532.58	
bottle wt. (#18)	54.76	
wt sample	477.82 g	
wt. after removing 1/5	429.24	
remaining wt.	374.48 g	(W95-Blank-F → to UMn)
subsample + bottle	122.2034	
bottle	18.8714	
wt. subsample	103.3320 g	(W95-Blank-F-2)

Outside of bottles wiped with damp Kimwipe, parafilm wrapped around cap, double bagged before mailing.

1/25/96
DAP

Starting this week, work which is a continuation of work performed under the Geochemical Natural Analog project will be conducted under the KTI - Radionuclide Transport as technical assistance.

Today begin:

Uranophane Samples for U/Pb dating

Will scrape uranophane off of selected Nopal I ore samples for possible U/Pb age dating. U/Pb will probably be done at the University of Texas by Larry Mack.
Am attempting fairly pure hand-picked separates, but this is very difficult. Uranophane needles are very friable. When attempt to remove, it is difficult to exclude grains from the host rock. Perhaps use heavy liquids later to purify.
Collecting in small snap-cap vials.

NOPI-494-UPb-1
Uranophane from a piece of NOPI-494, which is from an area of Level +10 with abundant uranophane. Scrape uranophane off surfaces and out of crevices in rock. Resulting powder looks like ~100 mg (?).

1/26/96
DAP

Continue...
Also keep rock from which a particular uranophane sample was scraped. Call it (sample #) - host, and keep in a zip loc bag.
DAP 1/26/96

NOPI-494-UPb-2

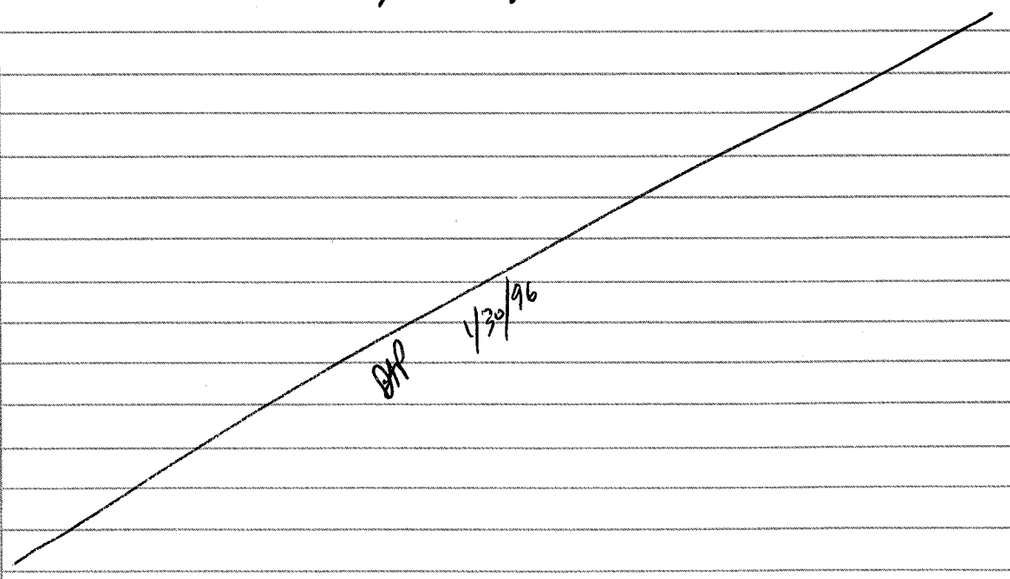
NOPI-494-UPb-3 - tried particularly hard to keep pure, as "yellow" as possible. There are tiny pinkish-~~organic~~ DAP 1/26/96 orangish grains that get mixed in. Fe coatings on uranophane?

1/26/96 cont.

NOPI-102-UPb Taken from very large piece of sample so no "host" sample taken.
(Equivalent to NOPI-ECP-26.85/11.65 — this is label on sample bag.)
Not on especially clean uranophane sample.

NOPI-291-UPb
Uranophane in a completely different textural setting. In bands and vugs in brown Fe oxide masses. Other samples treated here have uranophane needles growing on surfaces. This sample doesn't have visible needles. Yellow mass is formless. XRD data confirm it is α-uranophane

NOPI-104-UPb
This has both types of uranophane: chalky, formless as in NOPI-291, with crystalline acicular grains growing on surface. This UPb sample is an attempt to take only the older "chalky" uranophane. Visible needles were removed from sampled powder.



1/30/96
DtP

This work is continued in notebook "AN-4",
CNWRA # 126, p. 18.
(i.e. 126/18).