Bruce Geller
Advanced Geologic Services
700 Vista Lane
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(303)237-2947

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April 17, 2006

Summary

X-ray diffraction study confirms that the green translucent vein material submitted from Nevada is mostly opal, consistent with many of the physical properties tested such as hardness, luster, and fracture. Chemical analyses obtained via X-ray fluorescence confirms that a vast majority of the sample is opal, and is colored by 4% copper. A proposed mineral mixture for the entire 8 gram sample suggested by X-ray diffraction and X-ray fluorescence is approximately: 80% opal, 11% chrysocolla, 6% quartz (from the vein wall), 3% muscovite (also from the vein wall), and traces of montmorillonite, dolomite, and amorphous Al and Fe (or possibly both substituting for copper in the chrysocolla). The color of the material is unique in my experience. Due to its beauty, hardness, and rarity, it is suggested that this opal possesses lapidary applications.

Discussion

This material possesses all the correct physical properties of opal in terms of hardness, translucence, greasy luster, and conchoidal fracture. The sample was rubbed vigorously with a Q-tip immersed in acetone to determine whether it had been artificially dyed by organic pigments, but no color was imparted to the cotton swab. What makes this specimen so unusual is its remarkable blue/green color, faint reaction with 10% HCl, and vague radioactivity.

It is inferred that the faint reaction to dilute HCl is due to the presence of minor carbonate minerals, such as dolomite, as suggested by X-ray fluorescent analyses. Ultraviolet study revealed that the vague radioactivity was caused by traces of uranyl ion in the sample, supported by

the 310 ppm U detected by X-ray fluorescence. Curiously, the highest readings correlate with the bluest portion of the sample, farthest from the most fluorescent portions of the sample.

Next, a portion of the sample visibly containing the deepest coloration was carefully removed, crushed, and separated from the surrounding matrix. (The matrix consists of coarse rounded quartz and muscovite grains, representing sedimentary, igneous, or mylonitic origins). Then, the sample was subjected to X-ray diffraction study.

The material was found to be mostly the monoclinic form of tridymite (SiO_2), which is a common constituent in certain opals. It forms near the earth's surface at temperatures below about 105°C (Foord, E., 1997, p.1571). Other minor to trace constituents include montmorillonite, and probably the copper mineral chyrsocolla or a minor amount of ajoite. No wall rock quartz or muscovite was detected using this method, proving the purity of the crushed vein material selected for diffraction study.

Chemical analyses were obtained via X-ray fluorescence from The Mineral Lab of Lakewood, CO in order to verify X-ray diffraction results and to investigate the cause of the distinct blue/green coloration in the opal. The entire 8 gram sample was submitted for crushing and analysis.

Analysis of those results (Table 1) indicates reasonable levels of Na_2O, Al_2O_3, SiO_2, and K_2O, suggesting the presence of major amounts of opal, plus minor quartz, and muscovite from the wall rock. Interestingly, the sample contains 4% copper (=39850 ppm Cu), inferred to cause the blue/green color. Other minerals probably present in trace amounts include montmorillonite, dolomite, and amorphous Al-Fe. Importantly, the sample contains insufficient phosphorous (<50 ppm) to generate more than trace amounts of minerals such as variscite or turquoise.

Optimally, SEM analysis could be employed to obtain information about the nature and analyses of the copper minerals present, depending how much accuracy is required to substantiate the proposed composition of the mineral mixture. On the other hand, SEM techniques may be inadequate to discriminate chrysocolla from ajoite, due to their chemical similarities. Such analyses require about a week to conduct and are fairly costly.

This material is distinctly blue/green, un-dyed, and possesses unusual color for an opal, making it desirable for the preparation of cabochons and carvings, and quite aesthetic. The only mentions of green opal in the geologic literature are samples from: Yugoslavia colored by iron

Advanced Geologic Services
XRF Results for Sample, "Green Unknown"

April 12, 2006
Lab no. 206245

	Wt %												
Ident	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	S	Cl	K_2O	CaO	TiO_2	MnO	Fe_2O_3	BaO
SAMPLE	0.33	0.38	2.75	91.4	<0.05	<0.05	<0.02	0.85	0.25	0.04	<0.01	1.03	0.03
Quality Control - Replicate (R) sample and standard reference material (SY3) analyzed with sample													
SAMPLE(R)	0.34	0.37	2.77	91.5	<0.05	<0.05	<0.02	0.85	0.25	0.04	<0.01	1.03	0.03
SY3-XRF	4.55	2.52	12.5	61.4	0.69	<0.05	<0.02	4.65	8.26	0.12	0.30	6.16	0.06
SY3-known	4.15	2.67	11.8	59.7	0.54	0.05	0.014?	4.20	8.26	0.15	0.32	6.45	0.05

	PPM												
Ident	V	Cr	Co	Ni	W	Cu	Zn	As	Sn	Pb	Mo	Sr	U
SAMPLE	28	19	<10	<10	<10	39800	48	20	66	<10	<10	38	315
Quality Control													
SAMPLE(R)	29	17	<10	<10	<10	39900	48	<20	66	<10	<10	38	308
SY3-XRF	44	<10	17	<10	50	14	247	<20	<50	149	<10	308	710
SY3-known	51	10	12	11	--	16	250	20	--	130	--	306	650

	PPM				
Ident	Th	Nb	Zr	Rb	Y
SAMPLE	<10	<10	20	22	66
Quality Control					
SAMPLE(R)	<10	<10	19	22	71
SY3-XRF	1129	217	313	217	694
SY3-known	990	145	320	208	740

Analysis Performed By The Mineral Lab, Inc

Table 1. Chemical analysis of 8 gram vein and wall rock sample via X-ray fluorescence. Sample (top row) was re-run (third row) and compared to known geologic standards (4th and 5th rows). All values at top of table in parts per hundred (per cent). Other values in parts per million (ppm), where 10,000 ppm = 1%. Therefore 39850 (average of two analyses) = 3.99%. Note low phosphorus (P_2O_5), sulfur (S), chlorine (Cl), nickel (Ni), zinc (Zn), etc. values but elevated uranium (U) values.

(Poharc and Logar, 1998), Tanzania colored by Ni (Schmetzer, et al., 1976), and Japan colored by Ni (Sudo and Anzai, 1950), whereas this Nevada sample is clearly Ni deficient and Cu-rich to preclude the need for Fe in generating its color.

References Cited

Foord, E.E. IN Gaines, R.V. and Others, 1997, Dana's New Mineralogy, John Wiley and Sons, Inc., NY, p.1570-2 + 1587-92.

Poharc, L.V. and Logar, M., 1998, Mineralogy and color origin of opals from the Bare locality, Sumadija, Geoloshki Anali Balkanskoga Poluostrva, 62:233-50.

Schmetzer, K. and Others, 1976, Green opal from Tanzania, Der Aufschluss, 27(11):381-4.

Sudo, T. and Anzai, T., 1950, On certain green minerals associated with some Japanese nickel ores, Proceed. of the Tokyo Imp. Acad., 18(7):400-5.

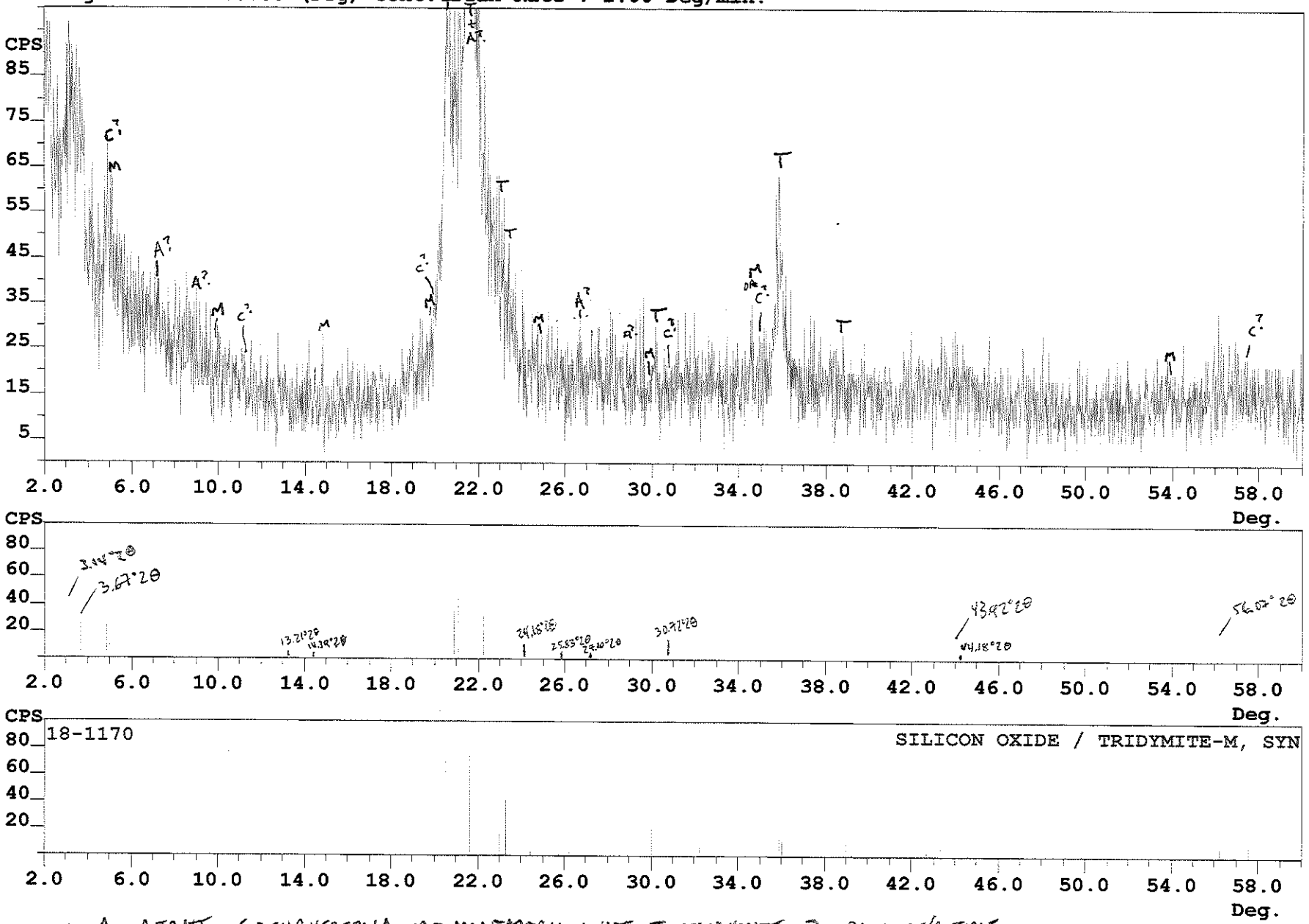
Respectfully,

Bruce Geller

Bruce Geller, Ph.D.

PRESENT

File: Nevadaunk, ID: blur/green Nevada unknown
Date: 04/04/06 14:28 Step : 0.020° Cnt Time: 0.600 Sec.
Range: 2.00 - 60.00 (Deg) Cont. Scan Rate : 2.00 Deg/min.



KEY: A = AJOITE, C = CHRYSOCOLLA, M = MONTMORILLONITE, T = TRIDYMITE, ? = PROBABLE/POSSIBLE.

WinSPIRS 5.00

No.	Records	Request
1	20021	green
2	3041	opal
* 3	44	#1 and #2

Record 1 of 7 - GeoRef 1997-2001

TI: Mineraloshke karakteristike i poreklo boje opala iz lokaliteta Bare, Shumadija--Mineralogy and color origin of opals from the locality Bare, Sumadija.
AU: Poharc-Logar-Vesna; Logar-Mihovil
AF: University of Belgrade, Faculty of Mining and Geology, Belgrade, Yugoslavia
SO: Geoloshki Anali Balkanskoga Poluostrva. 62; Pages 233-250. 1998.
PB: Geoloshki Zavod Univerziteta u Beogradu. Belgrade, Yugoslavia. 1998.
CP: Yugoslavia
PY: 1998
LA: Serbian; English
AB: Three representative samples of opals, intensively colored (green, yellow and red) from the locality Bare were investigated. The study of opals was carried out by means of the chemical, x-ray powder diffraction, thermal analysis as well as by infrared and optical absorption spectra. All data allowed identification of opals as opal-CT and proved that color is directly connected with the presence and concentration of iron.
DE: absorption-; chemical-composition; collecting-; color-; density-; differential-thermal-analysis; diffractograms-; Europe-; framework-silicates; gems-; geophysical-methods; infrared-methods; infrared-spectra; iron-; metals-; mineral-localities; opal-; opal-CT; optical-properties; Serbia-; silica-minerals; silicates-; Southern-Europe; spectra-; thermal-analysis; X-ray-diffraction-data; Yugoslavia-
CC: 01B-Mineralogy-of-silicates
DT: Serial
BL: Analytic
IL: Refs: 21; illus. incl. 3 tables.
RF: GeoRef, Copyright 2002, American Geological Institute.
IS: 0350-0608
CO: GABPAG
AN: 2000-077741
UD: 200024

Record 2 of 7 - GeoRef 1975-1984

TI: Green opal from East Africa.
AU: Koivula-John-I; Fryer-C-W
AF: Gemol. Inst. Amer., Appl. Gemol. Dep., Santa Monica, CA, United States
SO: Gems and Gemology. 20; 4, Pages 226-227. 1984.
PB: Gemological Institute of America. Santa Monica, CA, United States. 1984.
CP: United-States
PY: 1984
LA: English
DE: Africa-; crystal-chemistry; East-Africa; economic-geology; framework-silicates; gems-; inclusions-; mineral-inclusions; opal-; order-disorder; physical-properties; silica-minerals; silicates-; Tanzania-; X-ray-data
CC: 28A-Economic-geology,-geology-of-nonmetal-deposits
DT: Serial
BL: Analytic
IL: Refs: 3; illus. incl. 1 table.
RF: GeoRef, Copyright 2002, American Geological Institute.
IS: 0016-626X
CO: GEGEA2
AN: 1985-029248
UD: 1985

Record 3 of 7 - GeoRef 1975-1984

TI: A green opal field trip; gem materials in Idaho.
AU: Bradbury-Fran-G
SO: Jewelry Making Gems and Minerals. 527, Pages 106-107. 1981.
PB: Gemac Corporation. Mentone, CA, United States. 1981.
CP: United-States
PY: 1981
LA: English
DE: collecting-; economic-geology; framework-silicates; gems-; Idaho-; Lemhi-County-Idaho; minerals-; opal-; popular-geology; Salmon-Idaho; silica-minerals; silicates-; United-States
CC: 28A-Economic-geology,-geology-of-nonmetal-deposits
DT: Serial
BL: Analytic

MC: LAT: N451000; N451500; LONG: W1135000; W1140000.
IL: illus.
RF: GeoRef, Copyright 2002, American Geological Institute.
IS: 0274-8193
AN: 1982-000829
UD: 1982

Record 4 of 7 - GeoRef 1975-1984
TI: Gruener Opal aus Tansania
Translated Title: Green opal from Tanzania.
AU: Schmetzer-K; Berdesinski-W; Krupp-H
AF: Univ. Heidelberg, Heidelberg, Federal Republic of Germany
SO: Der Aufschluss. 27; 11, Pages 381-384. 1976.
PB: Vereinigung der Freunde der Mineralogie und Geologie. Heidelberg, Federal Republic of Germany. 1976.
CP: Federal-Republic-of-Germany
PY: 1976
LA: German
LS: English
DE: Africa-; atomic-absorption-spectra; color-; East-Africa; framework-silicates; geochemistry-; green-; metals-; mineralogy-; minerals-; nickel-; opal-; optical-properties; silica-minerals; silicates-; spectra-; Tanzania-
CC: 01B-Mineralogy-of-silicates
DT: Serial
BL: Analytic
IL: Refs: 19; illus. incl. 1 table.
RF: GeoRef, Copyright 2002, American Geological Institute.
IS: 0004-7856
CO: AFSLAO
AN: 1983-005801
UD: 1983

Record 5 of 7 - GeoRef 1975-1984
TI: L' opale verte de la Fazenda Brejinho
Translated Title: The green opal of Fazenda Brejinho.
AU: Cassedanne-J-P; Cassedanne-J-O
SO: Bulletin - Association Francaise de Gemmologie. 43, Pages 6-7. 1975.
PB: Association Francaise de Gemmologie. Paris, France. 1975.
CP: France
PY: 1975
LA: French
DE: alteration-; Bahia-Brazil; Brazil-; clays-; color-; economic-geology; Fazenda-Brejinho; framework-silicates; gems-; green-; green-opal; igneous-rocks; minerals-; occurrence-; opal-; plutonic-rocks; silica-minerals; silicates-; South-America; ultramafics-
CC: 28-Economic-geology-of-nonmetal-deposits
DT: Serial
BL: Analytic
IL: illus.
RF: GeoRef, Copyright 2002, American Geological Institute.
IS: 0151-539X
CO: AFGIAN
AN: 1977-026719
UD: 1977

Record 6 of 7 - GeoRef 1785-1974
TI: La chapmanite de La Bessade (Haute-Loire)
Translated Title: Chapmanite from La Bessade, Haute-Loire.
AU: Perichaud-J-J; Pierrot-R
SO: Bulletin de la Societe Francaise de Mineralogie et de Cristallographie. 88; 2, Pages 294-299. 1965.
PB: Masson. Paris, France. 1965.
CP: France
PY: 1965
LA: French
AB: Chapmanite occurs as yellowish green material finely disseminated in flint and opal in the La Bessade vein, 60 km S of Clermont-Ferrand. Microprobe analysis confirms the composition of Sb(OH)Fe (sub 2) (SiO (sub 4)) (sub 2) . X-ray powder reflections are listed. On heating to 1050 degrees C in air chapmanite is converted to tripuhyite, or to hematite and cristobalite if heated in an inert atmosphere. The d.t.a. curve shows an exothermic peak at 775 degrees C.
DE: chapmanite-; Europe-; France-; La-Bessade; mineral-data; mineralogy-; Western-Europe
CC: 01-Mineralogy
DT: Serial
BL: Analytic
IL: illus. incl. sketch map.
RF: GeoRef, Copyright 2002, American Geological Institute. Reference includes data from Bibliography and Index of Geology Exclusive of North America, Geological Society of America, Boulder, CO, United States

IS: 0037-9328
CO: BUFCAE
AN: 1968-001496
UD: 1968

Record 7 of 7 - GeoRef 1785-1974

TI: On certain green minerals associated with some Japanese nickel ores.
AU: Sudo-Tosio-(Toshio); Anzai-Tosio
SO: Proceedings of the Imperial Academy (Tokyo). 18; 7, Pages 400-405. 1942.
PB: Nippon Gakushiin. Tokyo, Japan. 1942.
CP: Japan
PY: 1942
LA: English
AB: Notes occurrences of garnierite, nickeliferous opal, and chrome-bearing kaolinite, associated with Japanese nickel ores in various localities. X-ray powder photograph data for these minerals are compared with those of specimens of garnierite from New Caledonia and genthite from North Carolina.
DE: Asia-; chromiferous-; clay-minerals; Far-East; framework-silicates; garnierite-; Green-minerals; Japan-; kaolinite-; metal-ores; mineral-data; mineralogy-; nickel-ores; nickeliferous-; opal-; serpentine-group; sheet-silicates; silica-minerals; silicates-
CC: 27-Economic-geology-of-ore-deposits
DT: Serial
BL: Analytic
IL: illus.

IS: 0369-9846
AN: 1950-003322
UD: 1950

WinSPIRS 5.00

No.	Records	Request
1	20021	green
2	3041	opal
3	44	#1 and #2
4	31829	Nevada
5	578	tridymite
6	9	#4 and #5
7	257	#1 and #4
8	2	#2 and #7
9	257	#7

Record 5 of 10 - GeoRef 1975-1984

TI: The natural formation and occurrence of green quartz.
AU: Paradise-Thomas-R
SO: Gems and Gemology. 18; 1, Pages 39-42. 1982.
PB: Gemological Institute of America. Santa Monica, CA, United States. 1982.
CP: United-States
PY: 1982
LA: English
DE: California-; framework-silicates; genesis-; green-quartz; mineralogy-; minerals-; Nevada-; silica-minerals; silicates-; United-States
CC: 01B-Mineralogy-of-silicates
DT: Serial
BL: Analytic
IL: Refs: 6; illus.
RF: GeoRef, Copyright 2002, American Geological Institute.
IS: 0016-626X
CO: GEGEA2
AN: 1983-020250
UD: 1983

The Mineral Lab, Inc.
2700 Youngfield Suite 105
Lakewood, CO 80215
(303) 232-8708

April 12, 2006
Lab no. 206245

Mr. Bruce Geller
Advanced Geologic Services
700 Vista Lane
Lakewood, Colorado 80214

Dear Mr. Geller:

Enclosed are the x-ray fluorescence (XRF) results for the sample, "Green Unknown" received last week. This report will emailed and mailed to you.

A representative portion of the sample was ground to approximately -400 mesh in a steel swing mill and then analyzed by our standard XRF procedure for 31 major, minor and trace elements. The relative precision/accuracy for this procedure is ~5–10% for major–minor elements and ~10–15% for trace elements (those elements listed in ppm) at levels greater than twice the detection limit in samples of average geologic composition. A replicate sample and a standard reference material ("SY3", a CANMET standard rock) were analyzed with the sample to demonstrate analytical reproducibility for your sample and analytical accuracy for a geologic standard, respectively. The accepted ("known") values for the quality control standard are listed with the XRF results.

Thank you for the opportunity to be of continuing service to Advanced Geologic Services.

Sincerely,

Joy Maes

Joy Maes