APPENDIX B
SAMPLE ADEQUACY EVALUATION FOR ROSEMONT GEOLOGIC MATERIALS

B1.0 INTRODUCTION

An open pit copper mine and ore processing operation are planned for the Rosemont Copper Project (Rosemont) site, located approximately 30 miles southeast of Tucson, Arizona. Processing of approximately 546 million tons (Mt) of sulfide ore and 69 Mt of oxide ore is expected to generate up to 1,232 Mt of waste rock during the anticipated 20-25 year mine life. Consequently, a baseline geochemical characterization was prepared which focused on the potential water quality impacts from the various mine facilities (e.g., waste rock and dry stack tailings storage areas). One of the primary goals of the baseline characterization study was to test a representative number of samples in order to adequately characterize the geochemical behavior of the rock that would be developed from mining (Tetra Tech, 2007). The results from this geochemical testing can also be used to estimate the geochemistry of non-ore rocks in the final walls of the pit.

The exposed pit wall lithology will be dominated by arkosic rocks of the Willow Canyon Formation, the Horquilla Limestone, and Bolsa Quartzite, with less exposure of additional limestone, quartz monzonite porphyry, and andesite (Table B1). Most of the primary sulfide mineralization is hosted by the Horquilla, Colina, and Epitaph Limestones, although the total sulfide content of these Paleozoics is generally low compared to other southwest porphyry copper systems (Tetra Tech, 2007). In fact, the total sulfur content of the overlying arkosic and andesitic lithologies is generally higher than the remainder of the deposit. A total of 226 applicable samples were subsequently submitted for standard static testing procedures.

The most commonly-used static test is known as acid-base accounting (ABA), which measures the balance between the acid-producing potential (AP) and the acid-neutralizing potential (NP) (White and others, 1999). The AP is determined by sulfur analysis and determines the sulfur content associated with pyritic sulfur. The NP is determined by acid-titration and generally represents the carbonate content of the sample. The net-neutralizing potential (NNP) is the difference between these values (NNP = NP - AP) and is typically expressed in units of kilograms of calcium carbonate ($CaCO_3$) per ton of rock (kg $CaCO_3$/t rock, or kg/t). The NNP, together with the NP ratio (NP/AP), is an important parameter used to classify a material as either potentially-acid generating (PAG) or inert with respect to acid generation. Because the ABA characteristics for a given sample reflect the dominant mineralogic properties of the material (i.e., carbonate and sulfur mineral content), ABA results can be used to evaluate if a material has been adequately characterized with respect to its potential effects on water quality.

B2.0 TECHNICAL OBJECTIVE

The objective of this sample adequacy evaluation is to assess the degree to which results from geochemical testing represent the overall geochemical tendencies of various rock types at Rosemont.

B3.0 TECHNICAL EVALUATION

Numerous criteria for determining an adequate sample population have been suggested as a means of obtaining representative samples of waste rock (USEPA, 1983; USEPA, 1994; Maest and Kuipers, 2005; Runnells and others, 1997). However, because it is impossible to confidently predict the degree of heterogeneity of a material, it is impossible to predict in advance how many samples will be required to representatively characterize it. In concept, a perfectly homogeneous material requires only one sample. Because the degree of variability in geochemical properties of rock is unique to each site, a reasonable approach is to determine the sample requirement based upon site-specific variability.

Samples may be taken from over a reasonable volume of the rock unit under consideration and continuously characterized until no further significant variability is observed. Such a process explicitly determines the heterogeneity of geochemical characteristics and demonstrates an adequate level of characterization.

The evaluation of sample adequacy presented herein was conducted using the approach outlined by Runnells and others (1997), which utilizes statistical measures of central tendency (mean) and dispersion (standard deviation) (USEPA, 2000) to evaluate sample representation. The method uses a stepwise evaluation to evaluate the degree to which additional sample analysis improves the level of confidence for a given parameter. Once the naturally-occurring variability of a rock unit is established, specific samples may be selected for detailed characterization of water quality that results from contact with that material.

During the baseline geochemical characterization (Tetra Tech, 2007), samples of geologic materials were submitted for ABA testing in proportion to their expected occurrence in the waste rock. The previous baseline testing results can be found in Appendix A of the Geochemical Characterization Addendum 1 Report (Tetra Tech, 2007). A subsequent evaluation of these data using the approaches described above indicated that insufficient information existed for several of the rock types, and therefore additional geochemical analysis was conducted in 2008. This additional data was composited with data from Tetra Tech (2007) for subsequent analysis.

Illustration B1 shows the spatial extent of sampling of rock within the projected pit. In this illustration, the traces of the boreholes are shown as lines and the individual sample locations are shown as a colored segment of the line. Samples were collected from a relatively large volume in the area most proximal to mineralization, where variability of the unit would be expected to be greatest. Samples were also collected, although fewer in number, at more distal positions, where less variability was anticipated.

The final composite ABA data for the rock types analyzed (Table B2) were first listed in random order, and then a moving average and standard deviation were calculated for NNP. The resulting data were graphed. This analysis evaluates potential increasing convergence toward the population mean (average), and decreasing variability about the population mean, with increasing sample size. A given rock type was considered to be adequately characterized when increasing the sample size produces a change of <10% in the average NNP, and if the slope of the standard deviation approaches zero.

B4.0 RESULTS AND DISCUSSION

The statistical results (from the Geochemical Characterization Addendum 1 [Tetra Tech, 2007] and subsequent additional analyses) for NNP within each rock type evaluated are presented on Illustrations B2 through B14. Each illustration depicts the moving average and standard deviation of the NNP for a given rock type. Based on these results, the rock types which will be exposed on the pit walls have been adequately characterized. Increasing the number of samples associated with these materials for analysis would yield limited or no increased definition of their chemical characteristics, and consequently no further sampling was deemed necessary.

For example, Illustration B2 shows the variation in the moving average and standard deviation for the Willow Canyon Formation arkose NNP values. For the first few samples, the running average changes by more than 10% as the sample number increases, but with increasing sample size, very little change is seen for both the moving average and the standard deviation (Illustration B2). Therefore, increasing the number of arkose samples will not change the level of confidence in the average value, indicating that an adequate number of arkose samples have been analyzed. Similar trends are apparent for the remaining rock types, which includes the rock types that are expected to dominate the final pit wall exposure.

B5.0 CONCLUSIONS

Statistical evaluation of ABA data collected from the Rosemont geologic materials provides a method for evaluating sample adequacy using site-specific geochemical parameters, rather than relying on arbitrary literature criteria developed for mine materials in general. Application of a statistical technique to the Rosemont Project site indicates that an adequate number of samples have been analyzed to characterize their central geochemical tendency.

B6.0 REFERENCES

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TABLES

Table B1 Projected Exposed Areas and ABA Summary for Various Rock Types in the Rosemont Pit

Rock Type	% of Exposed Area	No. Samples Analyzed for ABA
Willow Canyon Formation, Arkose	29.3	55
Horquilla Limestone	16	26
Bolsa Quartzite	8.1	13
Abrigo Formation	7.5	6
Epitaph Formation	7.4	16
Tertiary Gravel	6.4	5
Colina Limestone	4.8	11
Earp Formation	4.0	14
Glance Conglomerate	3.8	4
Escabrosa Limestone	3.8	10
Concha	2.9	6
Martin Formation	2.5	7
Precambrian Granodiorite	1.0	0
Willow Canyon Formation, Andesite	0.89	38
Scherrer	0.62	0
Quartz Monzonite Porphyry	0.53	9
Overburden	0.15	6
TOTAL	100	226

Table B2 Summary of ABA Data Used to Evaluate Sampling Adequacy

Sample ID	Rock Type	# Samples	AP	NP	NNP	NNP - Mean	NNP - Std. Dev.
1561-03	Abrigo	1	0.3	665	665.0	665.0	
1561-01	Abrigo	2	0.3	439	439.0	552.0	159.8
1916-02	Abrigo	3	0.3	630	630.0	578.0	121.6
A818-01	Abrigo	4	0.3	693	693.0	606.8	114.8
1926-02	Abrigo	5	0.3	550	550.0	595.4	102.6
A780-01	Abrigo	6	0.3	501	501	579.7	99.5
AR2019-02	Andesite	1	0.3	44.2	44.2	44.2	
AR2021-01	Andesite	2	35.3	47.3	12.0	28.1	22.8
AR2030-06	Andesite	3	0.3	33.9	33.9	30.0	16.4
AR2010-03	Andesite	4	52.2	26.6	-25.6	16.1	30.9
AR2017-06	Andesite	5	0.3	39.6	39.6	20.8	28.7
A-820 245.5	Andesite	6	18.2	87.7	69.5	28.9	32.5
AR2009-03	Andesite	7	64.1	99.1	35.0	29.8	29.7
AR2014-03	Andesite	8	29.7	71.7	42.0	31.3	27.9
AR2017-01	Andesite	9	0.3	45.3	45.3	32.9	26.5
A-816 569	Andesite	10	28.9	121	92.1	38.8	31.2
AR2028B-01	Andesite	11	29.4	75.7	46.3	39.5	29.7
AR2043-01	Andesite	12	47.5	103	55.5	40.8	28.7
AR2013-01	Andesite	13	48.4	59.7	11.3	38.5	28.7
AR2013-02	Andesite	14	33.1	70.2	37.1	38.4	27.5

Table B2 Summary of ABA Data Used to Evaluate Sampling Adequacy

Sample ID	Rock Type	# Samples	AP	NP	NNP	NNP - Mean	NNP - Std. Dev.
AR2030-05	Andesite	15	5.3	47.7	42.4	38.7	26.6
AR2011-03	Andesite	16	68.8	54.2	-14.6	35.4	28.9
AR2032-01	Andesite	17	0.3	39.8	39.8	35.6	28.0
AR2026-01	Andesite	18	14.4	48.3	33.9	35.5	27.2
AR2038-04	Andesite	19	0.3	6.2	6.2	34.0	27.3
AR2029-01	Andesite	20	0.3	105	105.0	37.5	30.9
A-882 109	Andesite	21	12	71.6	59.6	38.6	30.5
AR2020-02	Andesite	22	5.3	50.1	44.8	38.9	29.8
AR2038-01	Andesite	23	0.3	13.7	13.4	37.8	29.6
AR2030-03	Andesite	24	11.9	68.5	56.6	38.6	29.2
1535-01	Andesite	25	34.1	41	6.9	37.3	29.3
AR2022-01	Andesite	26	34.1	88.5	54.4	37.9	28.9
AR2014-02	Andesite	27	123	105	-18.0	35.9	30.3
A808-01	Andesite	28	36.9	19	-17.9	34.0	31.4
AR2038-06	Andesite	29	0.3	38.9	38.9	34.1	30.9
A817-01	Andesite	30	45	46.8	1.8	33.0	30.9
A-886 888	Andesite	31	27.6	156	128.4	36.1	34.9
AR2016-01	Andesite	32	0.3	26.2	26.2	35.8	34.4
AR2037-01	Andesite	33	36.3	80.4	44.1	36.1	33.9
AR2038-03	Andesite	34	0.3	43.5	43.5	36.3	33.4
AR2017-05	Andesite	35	0.6	25.7	25.1	36.0	32.9
AR2013-03	Andesite	36	31.9	79	47.1	36.3	32.5
AR2025-03	Andesite	37	0.3	39.1	39.1	36.3	32.0
AR2025-01	Andesite	38	30.3	37.8	7.5	35.6	32.0
AR2037-02	Arkose	1	0.3	48.9	48.9	48.9	
AR2011-01	Arkose	2	0.3	10.5	10.2	29.6	27.4
A873-01	Arkose	3	0.3	78.9	78.9	46.0	34.4
1596-01	Arkose	4	0.3	65.6	65.6	50.9	29.8
AR2035-01	Arkose	5	0.3	44.8	44.5	49.6	25.9
VABH0609-01	Arkose	6	0.3	4.3	4.3	42.1	29.7
AR2009-02	Arkose	7	0.3	19.6	19.6	38.9	28.4
AR2004-01	Arkose	8	0.3	56.2	56.2	41.0	27.0
AR2036-01	Arkose	9	7.2	103	95.8	47.1	31.2
AR2020-01	Arkose	10	0.3	13.9	13.9	43.8	31.2
AR2005-01	Arkose	11	0.3	35.6	35.6	43.0	29.7
AR2002-01	Arkose	12	1.6	27.1	25.5	41.6	28.8
AR2011-02	Arkose	13	0.3	21.6	21.6	40.0	28.1
AR2026-02	Arkose	14	0.3	108	108.0	44.9	32.5
AR2017-07	Arkose	15	41.6	74.6	33.0	44.1	31.5
AR2013-05	Arkose	16	9.1	82.8	73.7	46.0	31.3
AR2003-01	Arkose	17	0.3	37.6	37.6	45.5	30.4
AR2009-01	Arkose	18	0.3	52.7	52.7	45.9	29.5
A857-01	Arkose	19	0.3	91.6	91.6	48.3	30.6
AR2040-01	Arkose	20	0.3	7.7	7.4	46.2	31.1
AR2025-01	Arkose	21	30.3	37.8	7.5	44.4	31.5

Table B2 Summary of ABA Data Used to Evaluate Sampling Adequacy

Sample ID	Rock Type	# Samples	AP	NP	NNP	NNP - Mean	NNP - Std. Dev.
AR2001-02	Arkose	22	0.3	26.1	25.8	43.5	31.0
AR2005-02	Arkose	23	29.4	34.1	4.7	41.9	31.3
AR2041-01	Arkose	24	13.1	44.3	31.2	41.4	30.7
AR2030-04	Arkose	25	0.3	63.5	63.5	42.3	30.4
AR2014-01	Arkose	26	0.3	31.1	31.1	41.9	29.9
AR2039-03	Arkose	27	20.3	24.8	4.5	40.5	30.2
AR2007-01	Arkose	28	0.3	74	74.0	41.7	30.3
AR2017-03	Arkose	29	40.9	73.2	32.3	41.4	29.8
AR2003-03	Arkose	30	20.6	31.1	10.5	40.3	29.8
AR2038-05	Arkose	31	0.3	16.6	16.6	39.6	29.6
AR2019-01	Arkose	32	0.3	11.8	11.8	38.7	29.5
AR2013-04	Arkose	33	6.9	70.2	63.3	39.4	29.4
AR2036-03	Arkose	34	5	75.2	70.2	40.3	29.4
AR2030-02	Arkose	35	0.3	97.2	97.2	42.0	30.5
AR2010-01	Arkose	36	0.3	19.6	19.6	41.3	30.3
AH4-01	Arkose	37	0.3	43.2	43.2	41.4	29.9
AR2042-02	Arkose	38	0.3	134	134.0	43.8	33.1
AR2003-02	Arkose	39	0.3	24.1	24.1	43.3	32.8
1920-01	Arkose	40	0.3	45.3	45.3	43.4	32.4
AR2039-06	Arkose	41	23.1	19.7	-3.4	42.2	32.8
AR2010-02	Arkose	42	13.8	17.6	3.8	41.3	32.9
AR2043-02	Arkose	43	32.2	175	142.8	43.7	36.0
AR2038-02	Arkose	44	0.3	100	100.0	45.0	36.6
A886-01	Arkose	45	1.9	9.1	7.2	44.1	36.6
AR2025-02	Arkose	46	15.9	71.9	56.0	44.4	36.3
A830-03	Arkose	47	0.3	17.6	17.6	43.8	36.1
Arkose (AR2054)	Arkose	48	0.3	8.3	8.3	43.1	36.1
A814-01	Arkose	49	0.3	90	90.0	44.0	36.3
AR2001-01	Arkose	50	0.3	27.1	27.1	43.7	36.0
AR2025-04	Arkose	51	6.3	31.1	24.8	43.3	35.7
AR2032-02	Arkose	52	0.3	36.5	36.5	43.2	35.4
A831-01	Arkose	53	0.3	29	28.7	42.9	35.1
AR2015-01	Arkose	54	0.3	73.3	73.3	43.5	35.0
AR2000-01	Arkose	55	0.3	42.7	42.7	43.5	34.7
AR2042-04	Arkose	56	0.3	111	111.0	44.7	35.6
AR2067-01	Bolsa	1	0.3	7.3	7.3	7.3	
AR2033-01	Bolsa	2	0.55	13.5	13.0	10.1	4.0
AR2059-01	Bolsa	3	2.74	2.7	0.0	6.7	6.5
VABH0608-01	Bolsa	4	0.3	2.6	2.6	5.7	5.7
AR2023-01	Bolsa	5	21.5	8.3	-13.2	1.9	9.8
A780-02	Bolsa	6	9.69	3.5	-6.2	0.6	9.4
A780-03	Bolsa	7	39.7	0.3	-39.7	-5.2	17.5
AR2066-01	Bolsa	8	15.4	38.1	22.7	-1.7	18.9
1561-02	Bolsa	9	6.03	1.5	-4.5	-2.0	17.7
AR2073-01	Bolsa	10	0.3	9.9	9.9	-0.8	17.1

Table B2 Summary of ABA Data Used to Evaluate Sampling Adequacy

Sample ID	Rock Type	# Samples	AP	NP	NNP	NNP - Mean	NNP - Std. Dev.
1561-04	Bolsa	11	0.54	4.2	3.7	-0.4	16.3
AR2072-01	Bolsa	12	5.47	10.4	4.9	0.0	15.6
AR2060-01	Bolsa	13	0.3	3.2	3.2	0.3	15.0
A852-01	Colina	1	74.8	203	128.2	128.2	
A840-01	Colina	2	0.3	492	492.0	310.1	257.2
A815-01	Colina	3	0.3	453	453.0	357.7	199.7
A865-01	Colina	4	3.4	129	125.6	299.7	200.2
AR2011-04	Colina	5	1.6	299	297.4	299.2	173.4
1914-01	Colina	6	18.1	403	384.9	313.5	158.9
1528-02	Colina	7	11.9	337	325.1	315.2	145.2
A860-01	Colina	8	2.2	354	351.8	319.8	135.0
AR 2010-04	Colina	9	0.3	930	930.0	387.6	239.4
AR2002-02	Colina	10	0.6	617	616	410.4	237.0
AR2041-02	Colina	11	1.6	221	220	393.1	232.1
AR2042-01	Concha	1	0.3	432	432.0	432.0	
AR2042-05	Concha	5	0.3	570	570.0	596.2	153.2
AH4-02	Concha	6	0.3	530	530.0	585.2	139.7
AR2006-01	Concha	8	0.3	740	740.0	627.6	142.1
A808-02	Concha	9	0.3	740	740.0	640.1	138.1
A804-01	Concha	11	0.3	889	889.0	651.7	150.9
AR2019-03	Earp	1	8.8	23.1	14.3	14.3	
AR2030-01	Earp	2	4.4	85.2	80.8	47.6	47.0
A849-01	Earp	3	1.81	208	206.2	100.4	97.4
A830-04	Earp	4	15.3	178	162.7	116.0	85.4
1528-01	Earp	5	4.4	182	177.6	128.3	79.0
1920-02	Earp	6	1.16	249	247.8	148.2	85.8
A845-01	Earp	7	4.1	26.2	22.1	130.2	91.7
AR2035-02	Earp	8	1.9	171	169.1	135.1	86.0
AR2017-02	Earp	9	0.3	47.4	47.4	125.3	85.6
A834-02	Earp	10	5.6	109	103.4	123.1	81.0
AR2000-03	Earp	11	8.1	112	103.9	121.4	77.1
AR2000-02	Earp	12	10.9	62.2	51.3	115.6	76.2
AR2014-05	Earp	13	10	104	94.0	113.9	73.2
AR2028B-02	Earp	14	0.3	58.4	58.4	109.9	71.9
AR2009-04	Epitaph	1	17.2	80.3	63.1	63.1	
A847-01	Epitaph	2	0.3	774	774.0	418.6	502.7
A828-01	Epitaph	3	5.47	165	159.5	332.2	385.6
A860-02	Epitaph	4	5	252	247.0	310.9	317.7
AR2040-02	Epitaph	5	0.3	707	707.0	390.1	327.3
A850-01	Epitaph	6	0.3	176	175.7	354.4	305.5
A860-03	Epitaph	7	0.3	405	405.0	361.6	279.5
1538-01	Epitaph	8	0.3	621	621.0	394.0	274.6

Table B2 Summary of ABA Data Used to Evaluate Sampling Adequacy

Sample ID	Rock Type	# Samples	AP	NP	NNP	NNP - Mean	NNP - Std. Dev.
AR2002-03	Epitaph	9	0.3	522	522.0	408.3	260.4
AR2034-02	Epitaph	10	0.3	928	928.0	460.2	295.4
A829-01	Epitaph	11	0.3	680	680.0	480.2	288.0
A825-01	Epitaph	12	0.3	933	933.0	517.9	304.1
A801-01	Epitaph	13	0.3	770	770	537.3	299.4
A830-01	Epitaph	14	0.3	638	638	544.5	288.9
AR2001-03	Epitaph	15	0.3	99.1	99.1	514.8	301.2
AR2014-04	Epitaph	16	0.3	584	584	519.2	291.5
A801-01	Epitaph	7	0.3	770	770.0	611.6	145.4
1580-01	Escabrosa	1	0.3	34.8	34.8	34.8	
1507-01	Escabrosa	2	0.3	912	912.0	473.4	620.3
A814-02	Escabrosa	3	0.3	874	874.0	606.9	495.8
A872-01	Escabrosa	4	0.3	203	203.0	506.0	452.4
AR2004-05	Escabrosa	5	0.3	880	880.0	580.8	426.0
1926-03	Escabrosa	6	0.3	862	862.0	627.6	398.0
A812-01	Escabrosa	7	0.3	112	112.0	554.0	412.3
1461-01	Escabrosa	8	0.3	788	788.0	583.2	390.6
1506-02	Escabrosa	9	0.3	838	838.0	611.5	375.1
A871-01	Escabrosa	10	0.6	570	569.4	607.3	353.9
AR2004-02	Glance	2	0.3	722	722.0	577.0	205.1
A805-01	Glance	3	0.3	473	473.0	542.3	156.9
1596-02	Glance	4	0.3	784	784.0	602.8	176.1
A834-01	Glance	10	0.3	519	519.0	628.0	135.7
A845-02	Horquilla	1	0.3	201	201.0	201.0	
A878-02	Horquilla	2	2.19	175	172.8	186.9	19.9
1530-01	Horquilla	3	32.2	202	169.8	181.2	17.2
AR2039-07	Horquilla	4	0.3	169	169.0	178.2	15.3
A809-01	Horquilla	5	0.6	219	218.4	186.2	22.4
A806-01	Horquilla	6	0.3	194	194.0	187.5	20.3
1596-03	Horquilla	7	6.25	212	205.8	190.1	19.7
A842-01	Horquilla	8	0.3	224	224.0	194.3	21.8
A866-02	Horquilla	9	0.3	766	766.0	257.9	191.6
AR2007-02	Horquilla	10	0.9	97.8	96.9	241.8	187.7
1502-01	Horquilla	11	0.3	887	887.0	300.4	263.7
AR2004-03	Horquilla	12	0.3	270	270.0	297.9	251.6
AR2043-03	Horquilla	13	0.3	449	449.0	309.5	244.5
AR2004-04	Horquilla	14	0.3	459	459.0	320.2	238.3
AR2042-03	Horquilla	15	0.3	285	285.0	317.8	229.8
AR2000-04	Horquilla	16	0.3	467	467.0	327.2	225.1
AR2017-08	Horquilla	17	0.3	251	251.0	322.7	218.8
AR2042-06	Horquilla	18	0.3	410	410.0	327.5	213.2
AR 2030-07	Horquilla	19	0.8	412	411.2	331.9	208.1
AR 2035-03	Horquilla	20	0.3	272	272.0	328.9	203.0

Table B2 Summary of ABA Data Used to Evaluate Sampling Adequacy

Sample ID	Rock Type	# Samples	AP	NP	NNP	NNP - Mean	NNP - Std. Dev.
AR 2000-05	Horquilla	21	0.3	862	862.0	354.3	229.5
AR 2015-02	Horquilla	22	0.3	874	874.0	377.9	249.9
AR 2043-05	Horquilla	23	42.7	272	229.3	371.5	246.1
AR 2006-02	Horquilla	24	0.3	167	167.0	363.0	244.3
AR 2032-03	Horquilla	25	0.3	154	154.0	354.6	242.8
AR 2004-06	Horquilla	26	0.3	590	590.0	363.7	242.3
A856-01	Martin	1	0.3	707	707.0	707.0	
1916-01	Martin	2	0.3	738	738.0	722.5	21.9
A866-01	Martin	3	0.3	599	599.0	681.3	73.0
1511-01	Martin	4	0.3	863	863.0	726.8	108.6
A878-01	Martin	5	4.1	576	571.9	695.8	116.8
1506-03	Martin	6	2	489	487.0	661.0	134.8
1461-02	Martin	7	0.3	876	876.0	691.7	147.5
AR2039-02	Overburden	1	1.6	19	17.4	17.4	
AR2039-05	Overburden	2	0.3	19.2	18.9	18.2	1.1
AR2039-04	Overburden	3	0.3	4.2	4.2	13.5	8.1
A821-01	Overburden	4	0.3	47.3	47.3	22.0	18.1
1485-01	Overburden	5	0.3	25.7	25.7	22.7	15.8
AR2039-01	Overburden	6	1.9	9.5	7.6	20.2	15.4
AR2036-04	QMP	1	0.3	0.3	0.0	0.0	
AR2034-01	QMP	2	0.3	2.1	2.1	1.1	1.5
A855-01	QMP	3	0.3	20.6	20.6	7.6	11.3
AR2037-03	QMP	4	0.3	36.7	36.7	14.9	17.3
1503-01	QMP	5	0.3	5.6	5.6	13.0	15.5
1926-01	QMP	6	0.3	12.2	12.2	12.9	13.9
1506-01	QMP	7	0.3	9.3	9.3	12.4	12.7
AR2036-02	QMP	8	0.3	4.7	4.7	11.4	12.1
A815-02	QMP	9	0.3	10.1	10.1	11.3	11.3

ILLUSTRATIONS

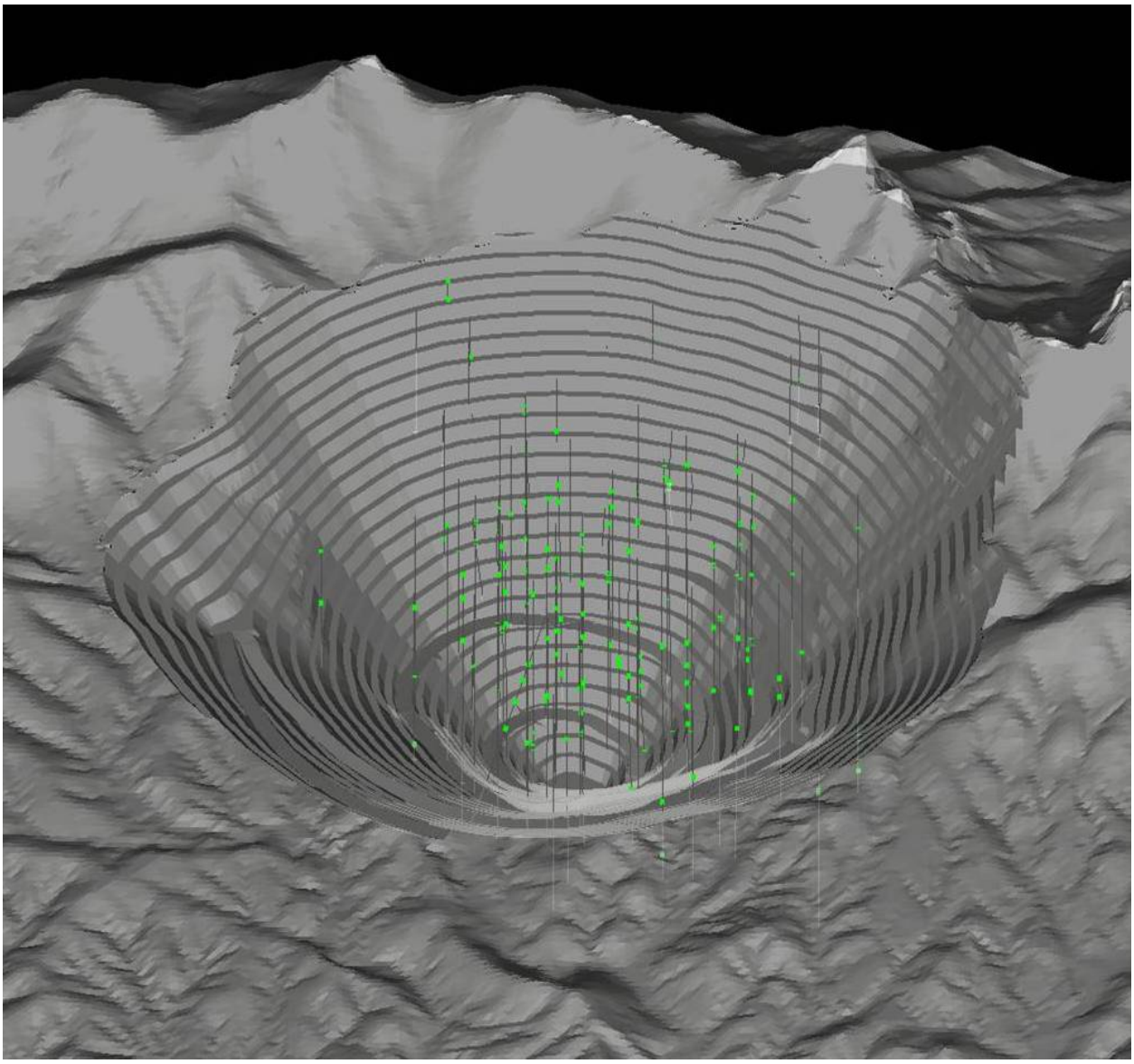

Illustration B1 Drill Holes and Samples Used to Characterize Non-Ore Rock

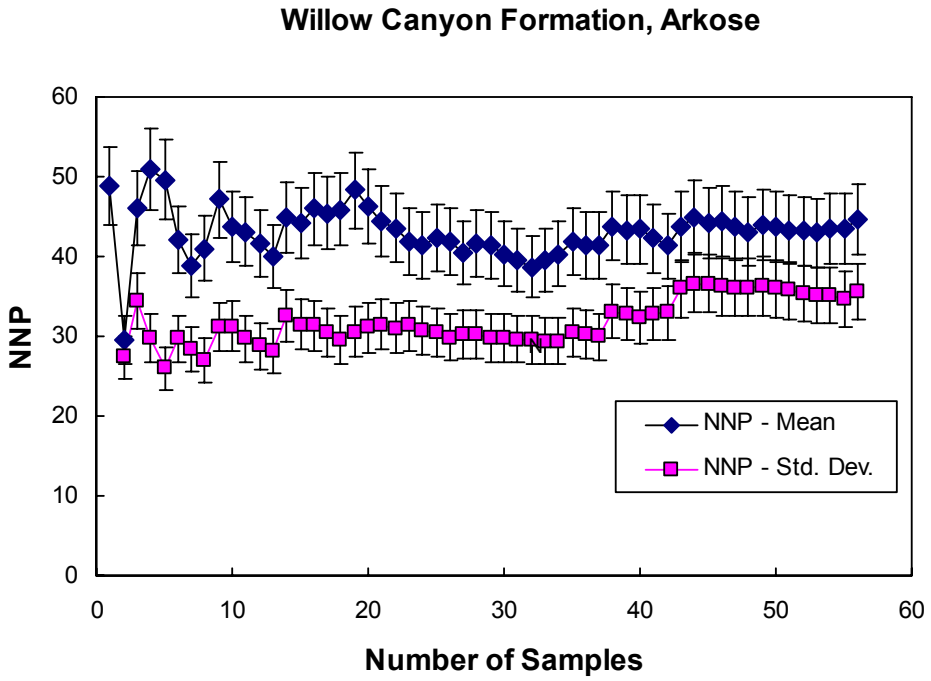

Illustration B2 **Moving Average and Standard Deviation of NNP Values for Rosemont Willow Canyon Formation Arkose Samples**

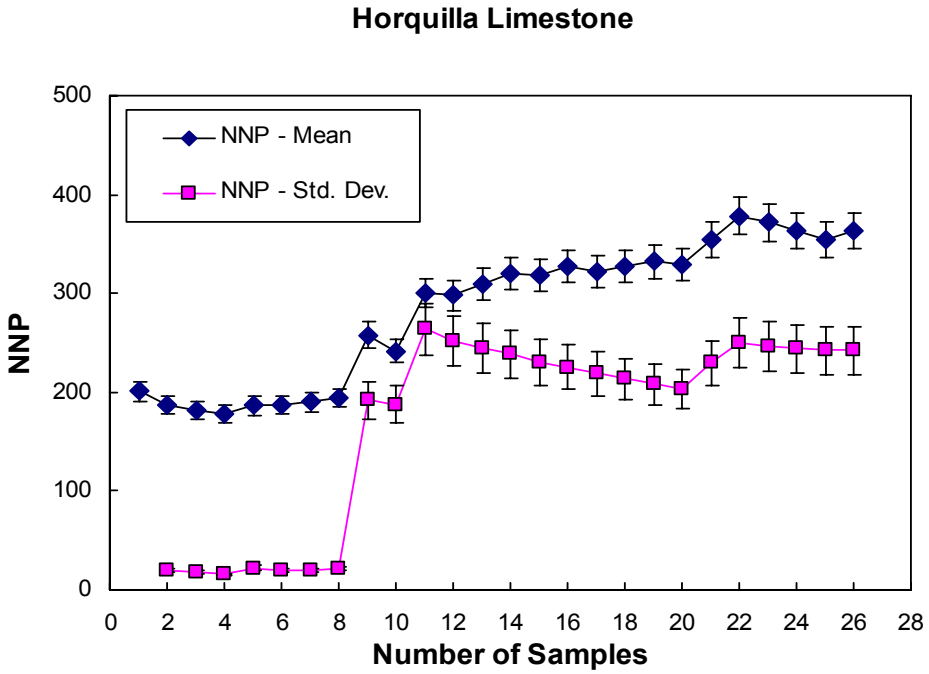

Illustration B3 **Moving Average and Standard Deviation of NNP Values for Rosemont Horquilla Limestone Samples**

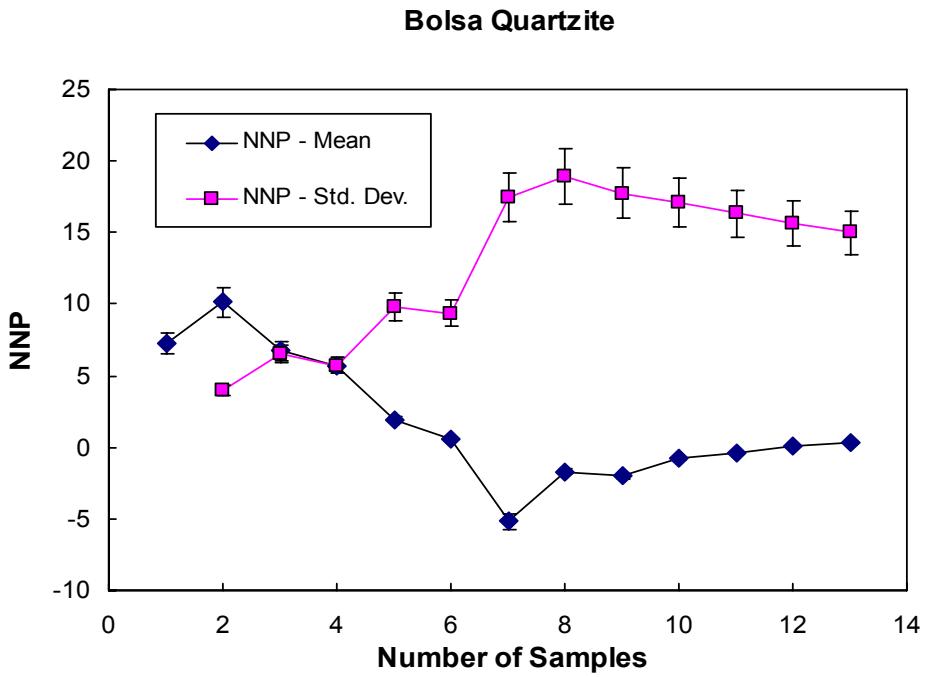

Illustration B4 **Moving Average and Standard Deviation of NNP Values for Rosemont Bolsa Quartzite Samples**

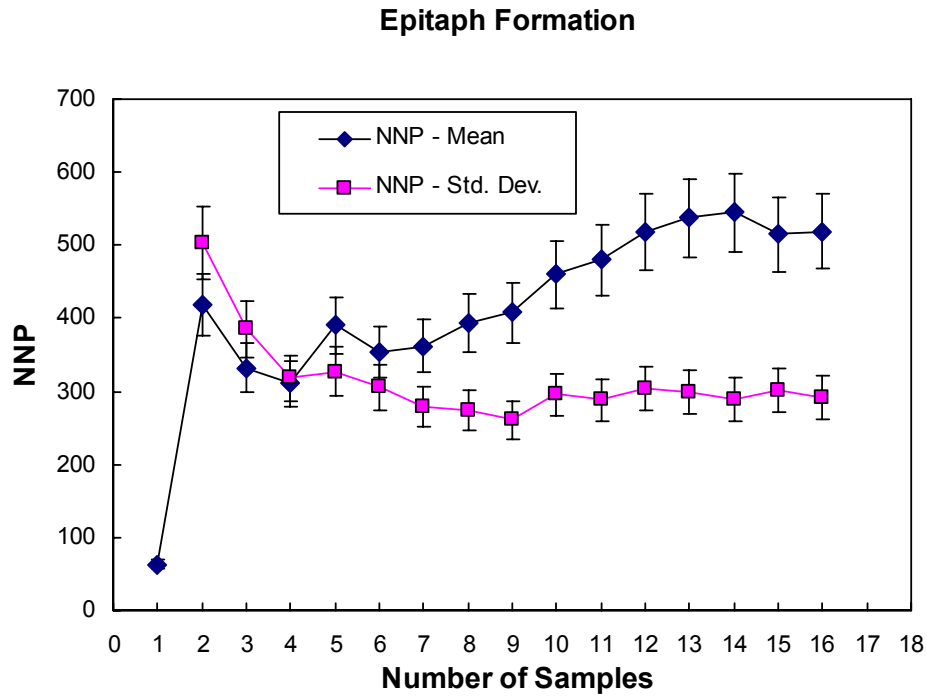

Illustration B5 **Moving Average and Standard Deviation of NNP Values for Rosemont Epitaph Formation Samples**

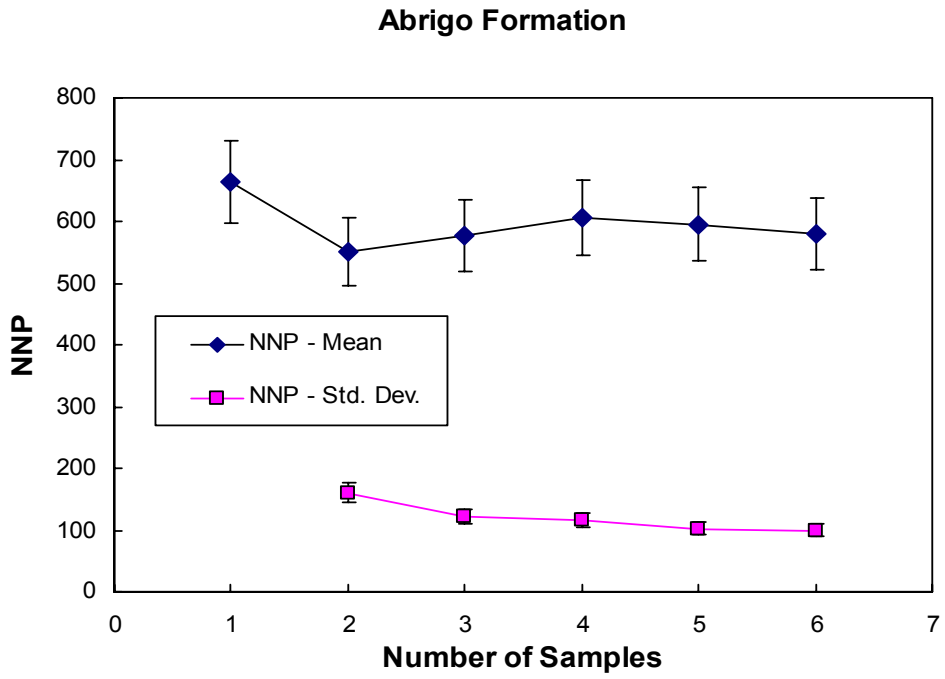

Illustration B6 **Moving Average and Standard Deviation of NNP Values for Rosemont Abrigo Formation Samples**

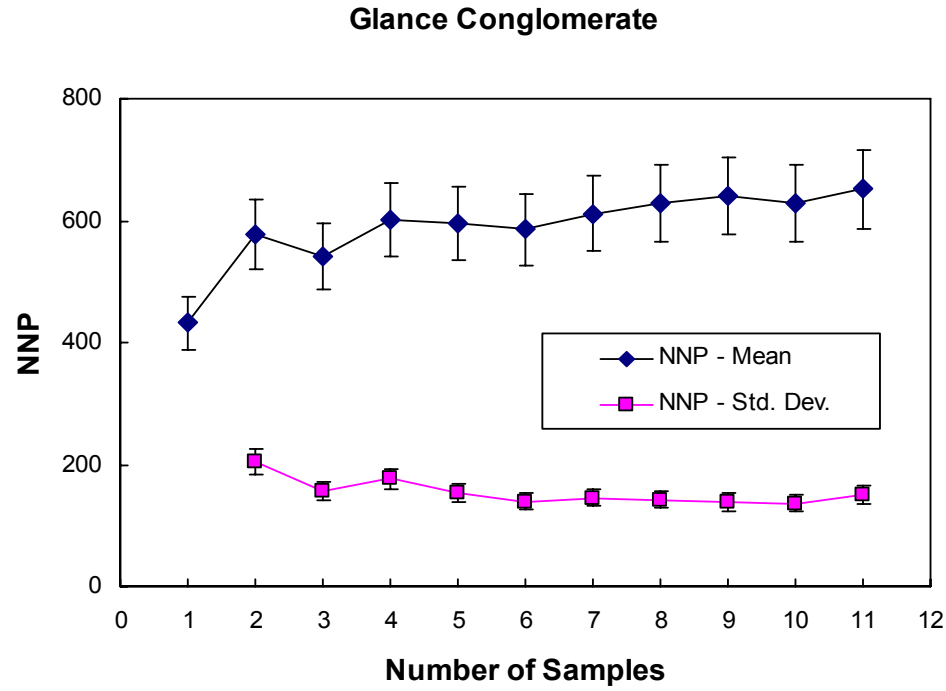

Illustration B7 **Moving Average and Standard Deviation of NNP Values for Rosemont Glance Conglomerate Samples**

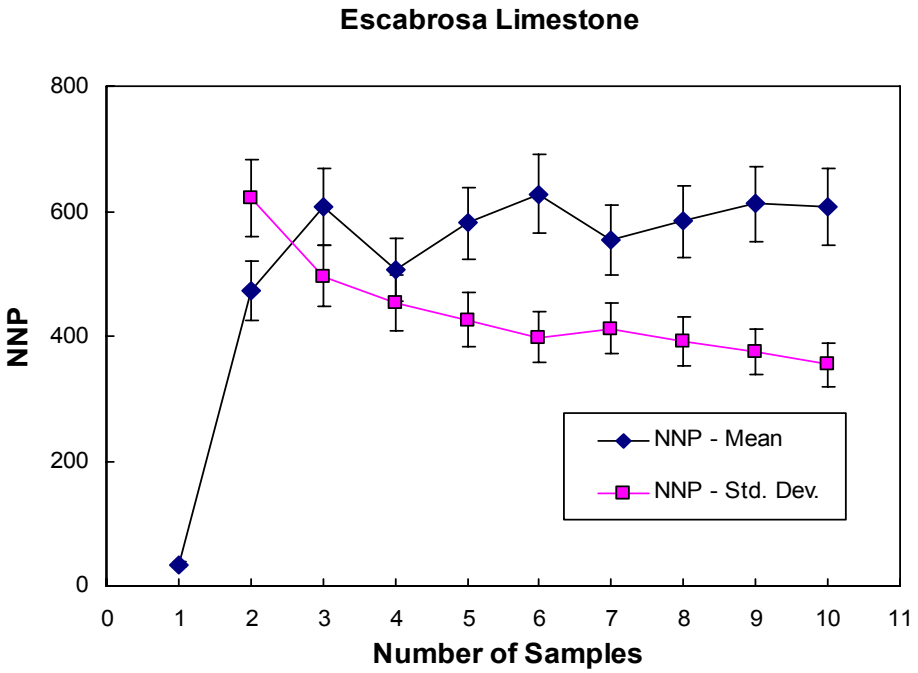

Illustration B8 **Moving Average and Standard Deviation of NNP Values for Rosemont Escabrosa Limestone Samples**

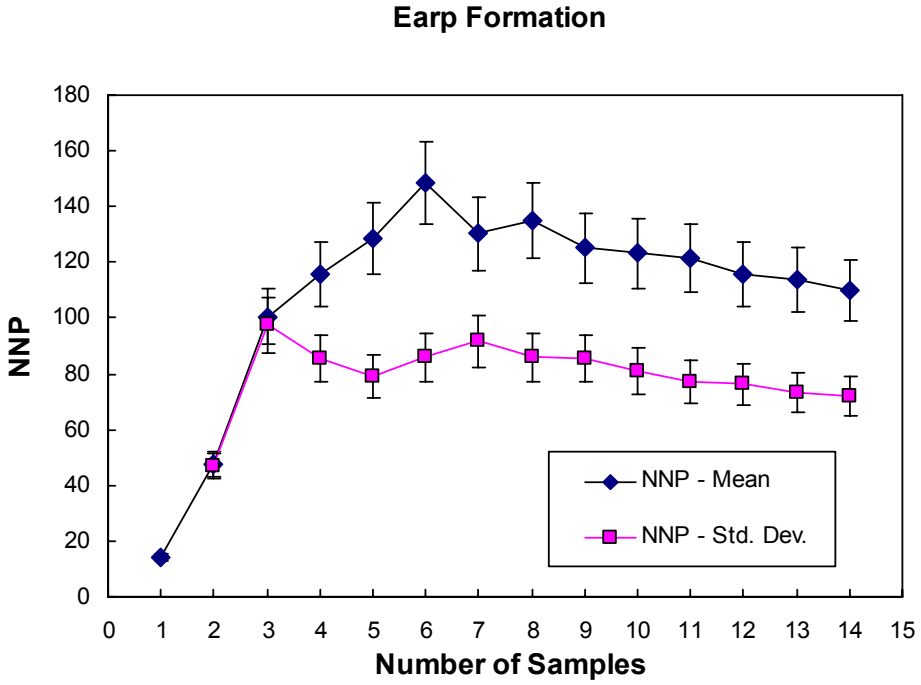

Illustration B9 **Moving Average and Standard Deviation of NNP Values for Rosemont Earp Formation Samples**

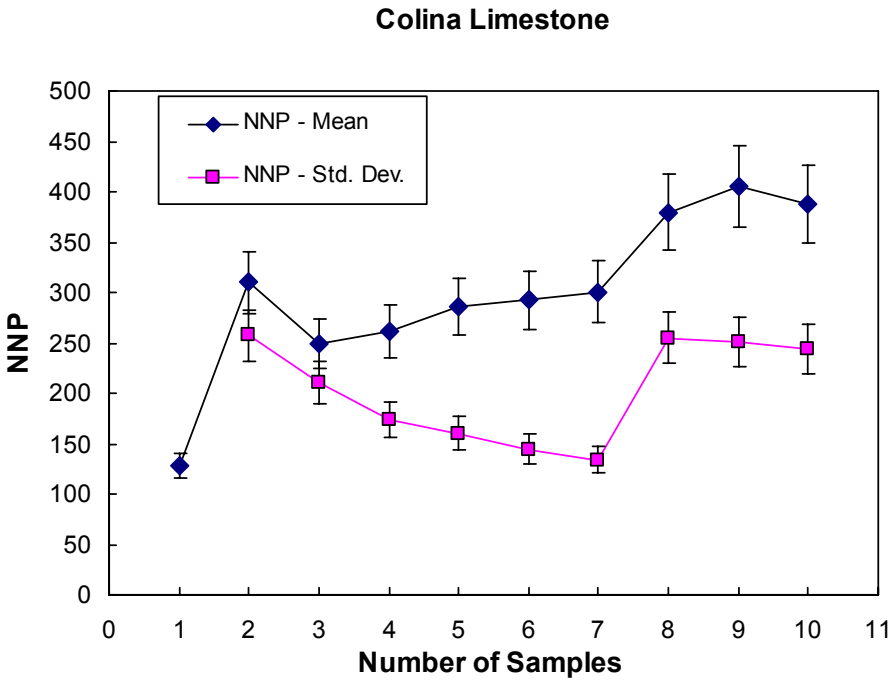

Illustration B10 **Moving Average and Standard Deviation of NNP Values for Rosemont Colina Limestone Samples**

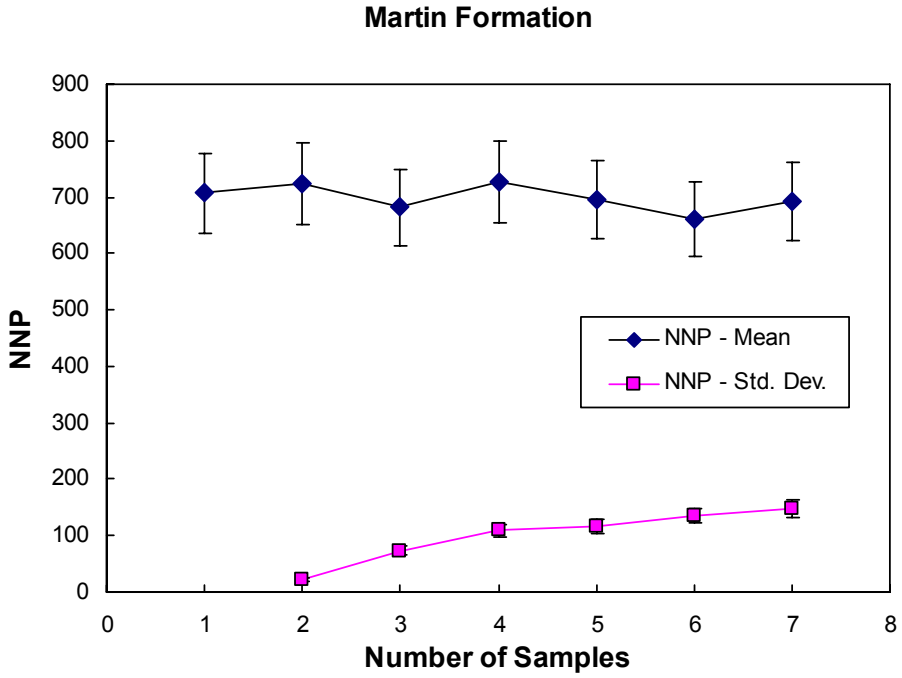

Illustration B11 **Moving Average and Standard Deviation of NNP Values for Rosemont Martin Formation Samples**

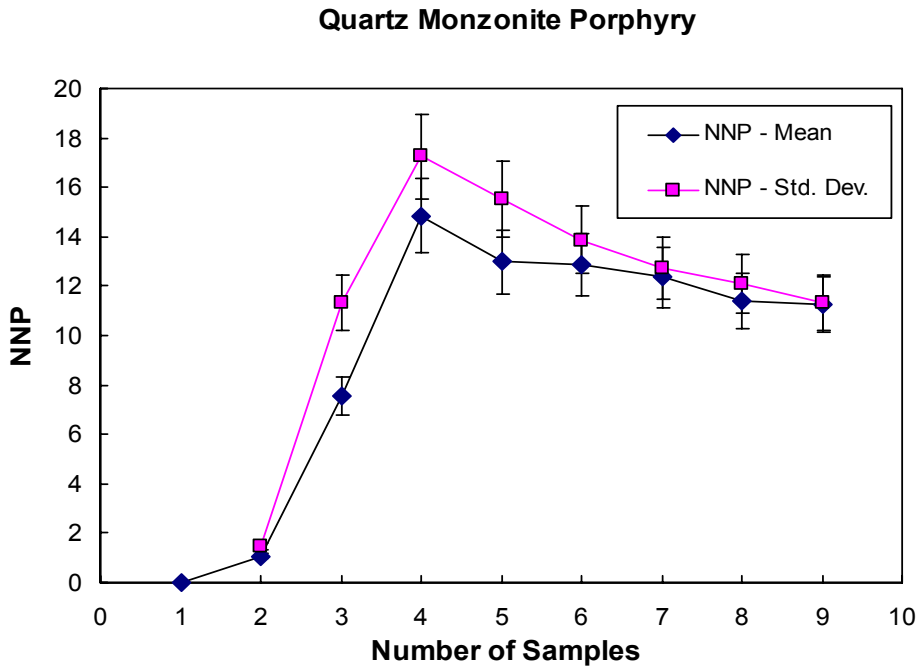

Illustration B12 **Moving Average and Standard Deviation of NNP Values for Rosemont Quartz Monzonite Porphyry Samples**

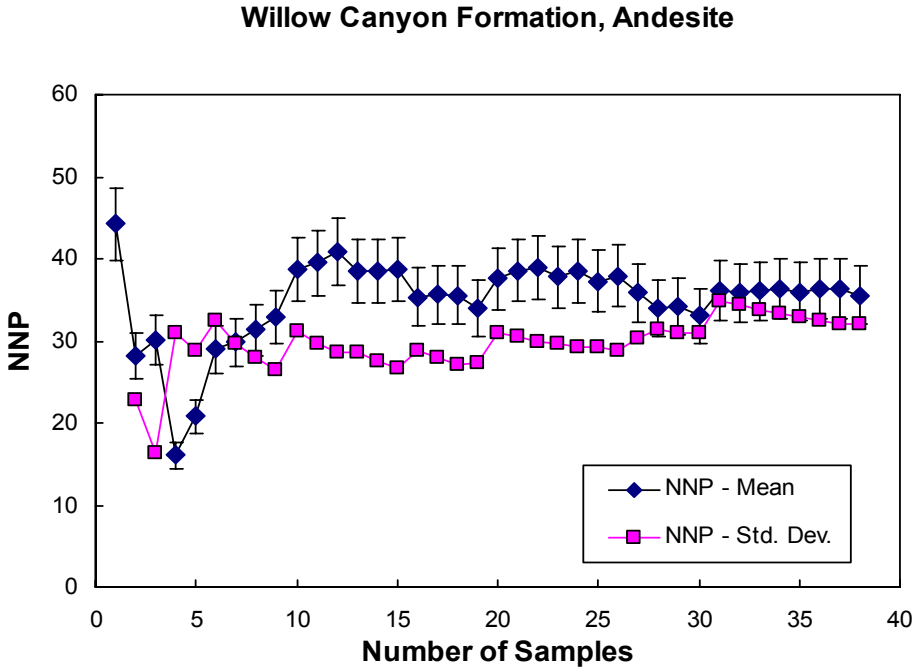

Illustration B13 **Moving Average and Standard Deviation of NNP Values for Rosemont Willow Canyon Formation Andesite Samples**

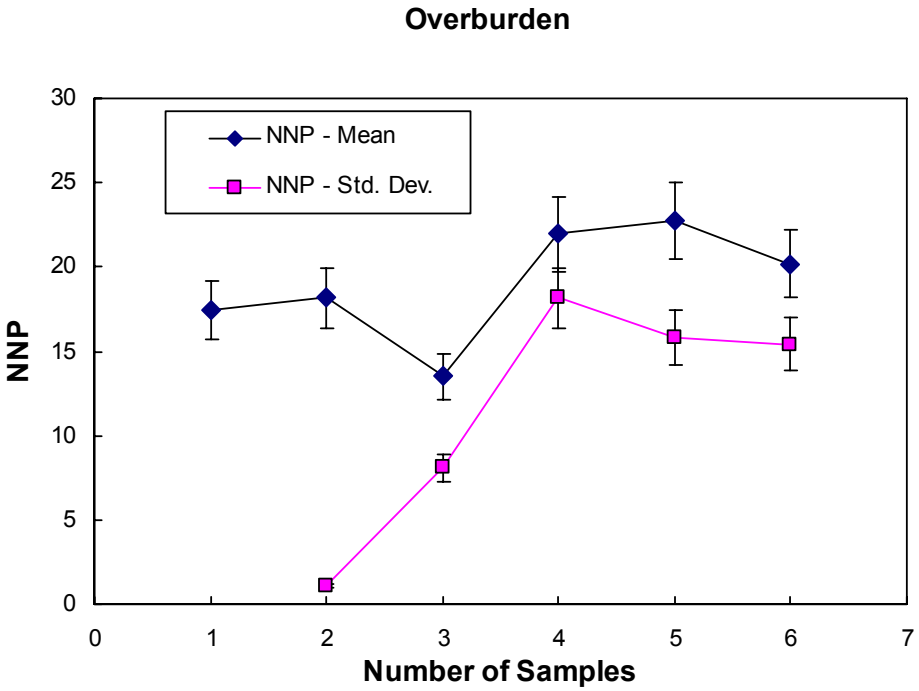

Illustration B14 **Moving Average and Standard Deviation of NNP Values for Rosemont Overburden Samples**