Appendix B

Nickel Statistical Background Memo

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16406 US Route 224 East
Findlay, OH 45840

Memorandum

Date: Thursday, October 27, 2005

To: Guy Gallello

CC:

From: John Carson, Ph.D.

RE: Results of Schenectady AD AOC-2 data analysis

As we discussed, I have analyzed the metals data from the excavations in AOC-2 of Schenectady Army Depot and the relevant background (BG) for the purpose of comparing mercury (Hg) and nickel (Ni) soil concentrations to BG.

Data

I started with the Excel files that you provided ('838360 AOC-2 Area B.xls', '838360 AOC-2 Area C.xls', '838360 AOC-2 Area F.xls' and 'AOC-2 Metal hits.xls'). Based on the field drawing you provided of the planned backfill area (Area B + part of Area C), I grouped those sample locations within the planned backfill area into an area B/C to facilitate the analysis. The data is listed in Attachment 3. I did not use the original data for locations that were resampled except for analysis of trace metals/ major metals relationships. For the comparisons of mean concentrations to BG, I used the data from duplicate sample pairs with weights of 0.5 for each member of the pair. Unduplicated samples were given a weight of one.

Nondetects

There were no nondetects (ND) for Ni and two ND for Hg among the sample results used in this analysis. A number of J-qualified results were also reported at values less than the reporting limit (RL). The ND were given as <RL, where RL was the sample specific reporting limit. The laboratory RLs are almost always greater than or equal to the limit of quantitation (LOQ) which is a little more than three times the limit of detection (LOD). When J-qualified results are reported, their estimated concentrations lie between the LOD and the LOQ. In this case, ND are actually between zero and the LOD but are reported as if they are between zero and the LOQ. Unless the ND are assumed to be zero (as in Aitchison's method), reporting ND as <RL when they are really <LOD creates a high bias in statistical procedures. This problem is known as *informative censoring* (see Helsel, chapter 3). If the ND is replaced by substituting RL/2, then that result is biased by a factor greater than three, since $RL \geq LOQ \geq 3 \cdot LOD$.

To reduce this high bias, when I know that an RL ≥LOQ is being used, I use RL/3 as the censoring point. This is applicable to any method of handling ND except for zero substitution. Since the mercury result for sample EX-B-3 was ND with a very high RL, 0.34, much higher than most of the reported data, I eliminated it from the analysis as it added almost no useful information. The other ND sample result (EX-C-10RE) was reported as '0.036 U' or < 0.036. I replaced the RL with RL/3, to approximate the LOD as discussed above, and used LOD/2 substitution in the analysis.

Computations

I used the public domain software R (http://www.r-project.org/), a language and environment for statistical computing and graphics. It is based on the S language and environment, which was developed at Bell Laboratories (formerly AT&T, now Lucent Technologies) by John Chambers and colleagues.

Comparison of Means

First, I used the nonparametric percentile bootstrap to compare the mean concentrations of Hg and Ni in the combined backfill areas B/C and in area F to the BG means. I used stratified bootstrap sampling with importance weights given by the sample weights mentioned above. I initially conducted four univariate tests, for Hg in area B/C, for Hg in area F, for Ni in area B/C and for Ni in area F, at the 5% significance level, by constructing 95% lower confidence limits (LCL) for the difference in means using the percentile method of constructing confidence intervals with 1000 bootstrap replications. If the LCL for an area/analyte is greater than 0, then that area/analyte fails the test and is deemed to (putatively) exceed BG.

Average Hg did not exceed BG in either area. Area C by itself significantly exceeded BG for Hg. However, over the planned backfill area B/C and in Area F, the sample mean Hg concentration was less than that for BG. Average Ni appeared to exceed BG in both in area F and in the combined backfill area B/C—more so in area B/C than in area F. The resulting 95% LCLs are given in Table 1. Because of the apparent failure for Ni, additional analysis was required.

Table 1: 95% LCLs for Mean Diff erence from BG

Analyte \ Area	Area B/C	Area F
Hg	-0.0292	-0.0287
Ni	10.75	0.838

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Predictive Analysis

Next I looked at the relation between Ni concentrations and the concentrations of the major constituent metals: aluminum (Al), calcium (Ca), iron (Fe), potassium (K) and magnesium (Mg). I found high correlation and strong linear relationships between Ni on one hand and Fe, K, Mg and the total of the major constituent metals on the other hand. The respective correlations with Ni were 0.92 for Fe, 0.90 for K, 0.73 for Mg and 0.81 for the total of major constituent metals. The full set of correlations is shown in Table 2.

Table 2: Correlations for Metals

	Hg	Ni	Al	Ca	Fe	K	Mg	Al+Ca+Fe+K+Mg
Hg	1.00	0.28	0.18	-0.11	0.25	0.24	0.12	0.11
Ni	0.28	1.00	0.55	0.26	0.92	0.90	0.73	0.81
Al	0.18	0.55	1.00	-0.25	0.63	0.68	0.25	0.39
Ca	-0.11	0.26	-0.25	1.00	0.13	0.26	0.64	0.71
Fe	0.25	**0.92**	0.63	0.13	1.00	0.84	0.63	0.77
K	0.24	**0.90**	0.68	0.26	0.84	1.00	0.72	0.80
Mg	0.12	**0.73**	0.25	0.64	0.63	0.72	1.00	0.88
Al+Ca+Fe+K+Mg	0.11	**0.81**	0.39	0.71	0.77	0.80	0.88	1.00

Aluminum is a surrogate variable for clay content. The total of major constituent metals is a surrogate variable for the total inorganic content minus sand. The relationship between Fe and Ni appeared to be consistently the same in all the zones: BG, area B/C and area F. The relationship between the other metals and Ni did not appear to be as consistent by zone. This is illustrated in Figures 1 (Ni versus Fe) and 2 (Ni versus K).

To verify this, I fit various linear models (Rao, chapter 4) predicting Ni. For the models with Fe as the only continuous covariate, I tested the effect of zone on both the intercept and the slope of the regression using Analysis of Covariance (ANCOVA), but neither was statistically significant. For K, Mg and the total of the major constituent metals, there were linear relationships of varying strength with Ni, but they appeared to change by zone. In linear models with the other metals as predictors, Area was always a statistically significant factor. The strength and consistency of the Ni-Fe relationship across zones shows that Ni is geochemically strongly associated with Fe.

To explore this further, I included all major metals and area into a large ANCOVA model. I whittled down the list of predictors, refitting the model at each step until only statistically significant predictors remained. The final model included Fe, K, Al, Area and the interaction between Al and Area. It predicts 91% of the variation in the Ni concentrations (Adjusted R-squared: 0.914) versus 83% for Fe as the only predictor. The role of K and Al probably relates to predicting the total silt and clay content of the soil. Ni concentration would be reduced as there is more sand or organics in the soil and increased as there is less.

The Ni levels appear higher in area B/C than in BG because the Fe levels are higher due to natural variation in the soil, as indicated by the boxplots in Figure 3, not because there is anthropogenic Ni contamination. In fact, after controlling for the concentrations of Fe, K and Al, **the estimated effects for areas B, C and F area actually *lower* than the effect for BG**. That means that based on modeling this data, for samples in each area having the same concentrations of Fe, K and Al, we would expect to see higher Ni concentrations in the samples from BG than in those from Areas B, C or F.

Conclusion

I conclude based on this analysis that there is no evidence that either Hg or Ni are elevated above BG in the studied areas: backfill area B/C and Area F. Please contact me if you have any questions about this analysis.

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References

Helsel, D. 2004. Nondetects and Data Analysis: Statistics for Censored Environmental Data. John Wiley. New York. 268 pp.

R Development Core Team (2005). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org.

Rao, C R. 1973. *Linear Statistical Inference and Its Applications*. Second Edition. John Wiley. New York. 625 pp.

Figure 1: Nickel versus Iron Relationship

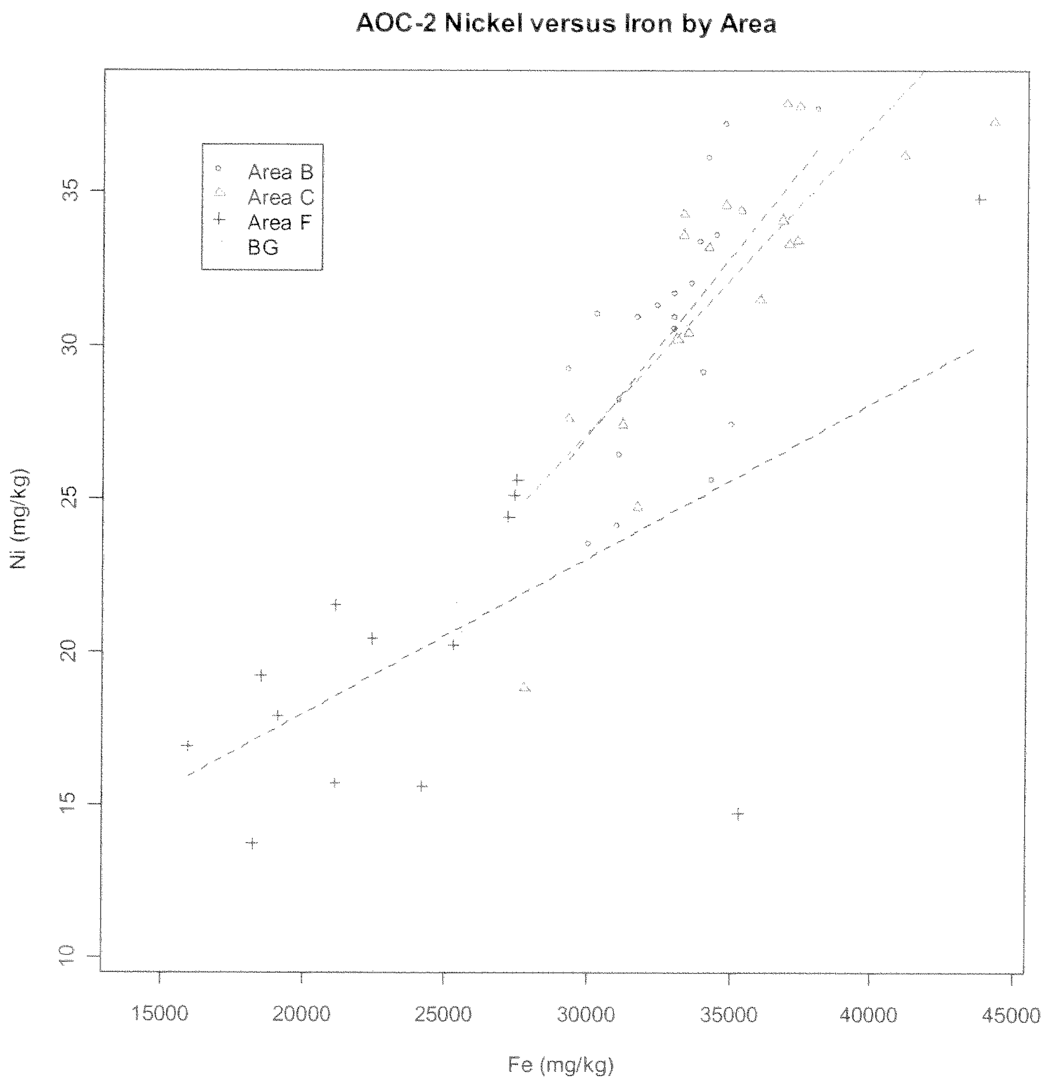


Figure 2: Nickel versus Potassium Relationship

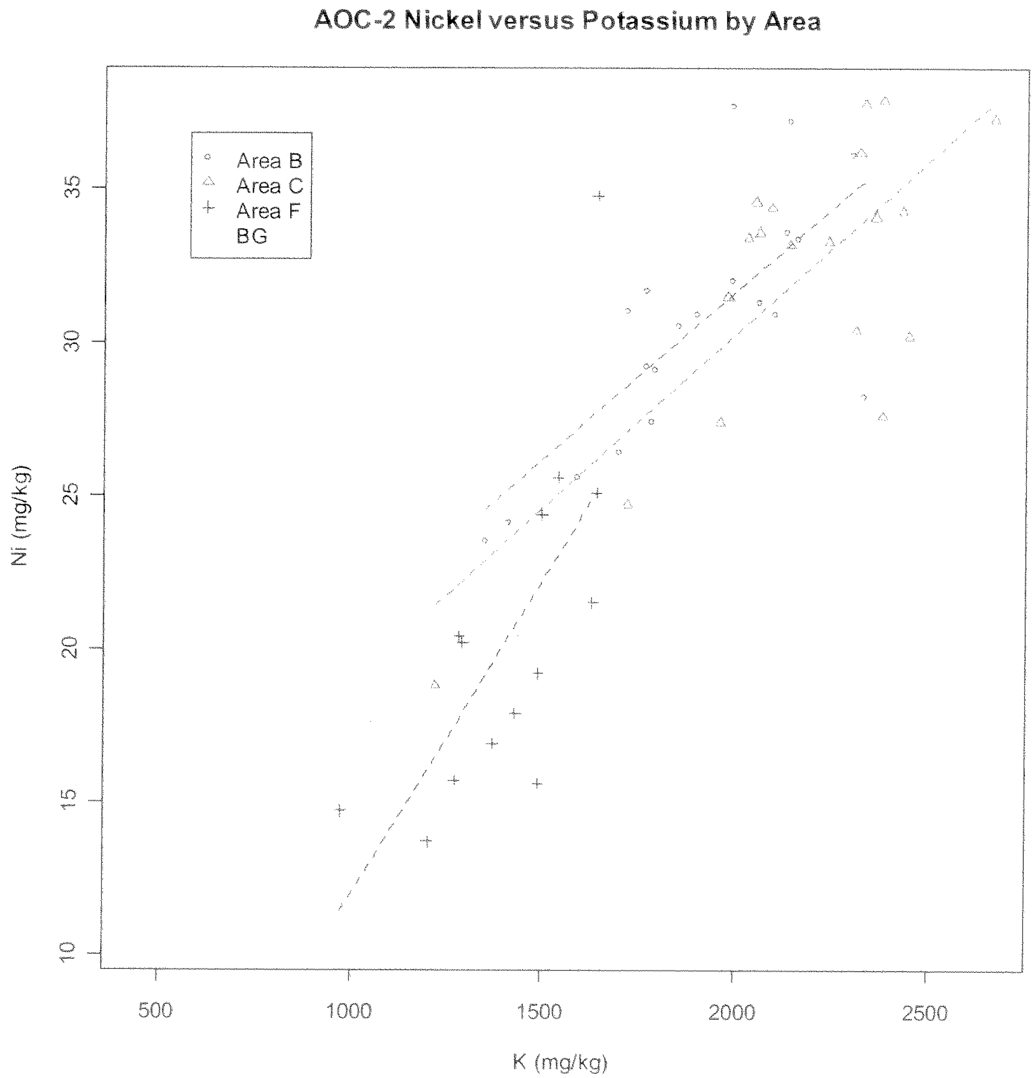
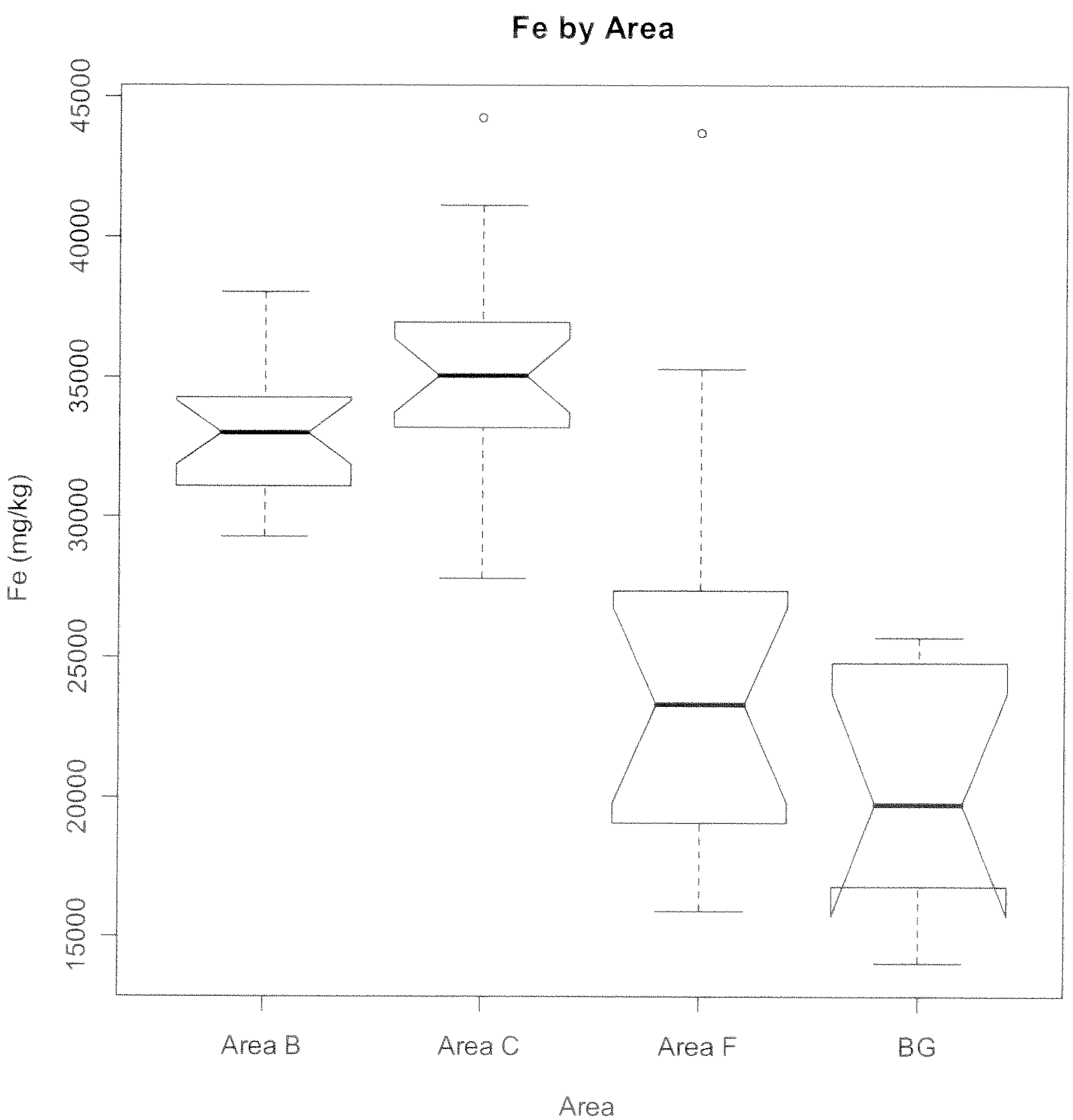


Figure 3: Boxplots of Iron Concentration by Area



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Attachment 1: Supporting Graphs

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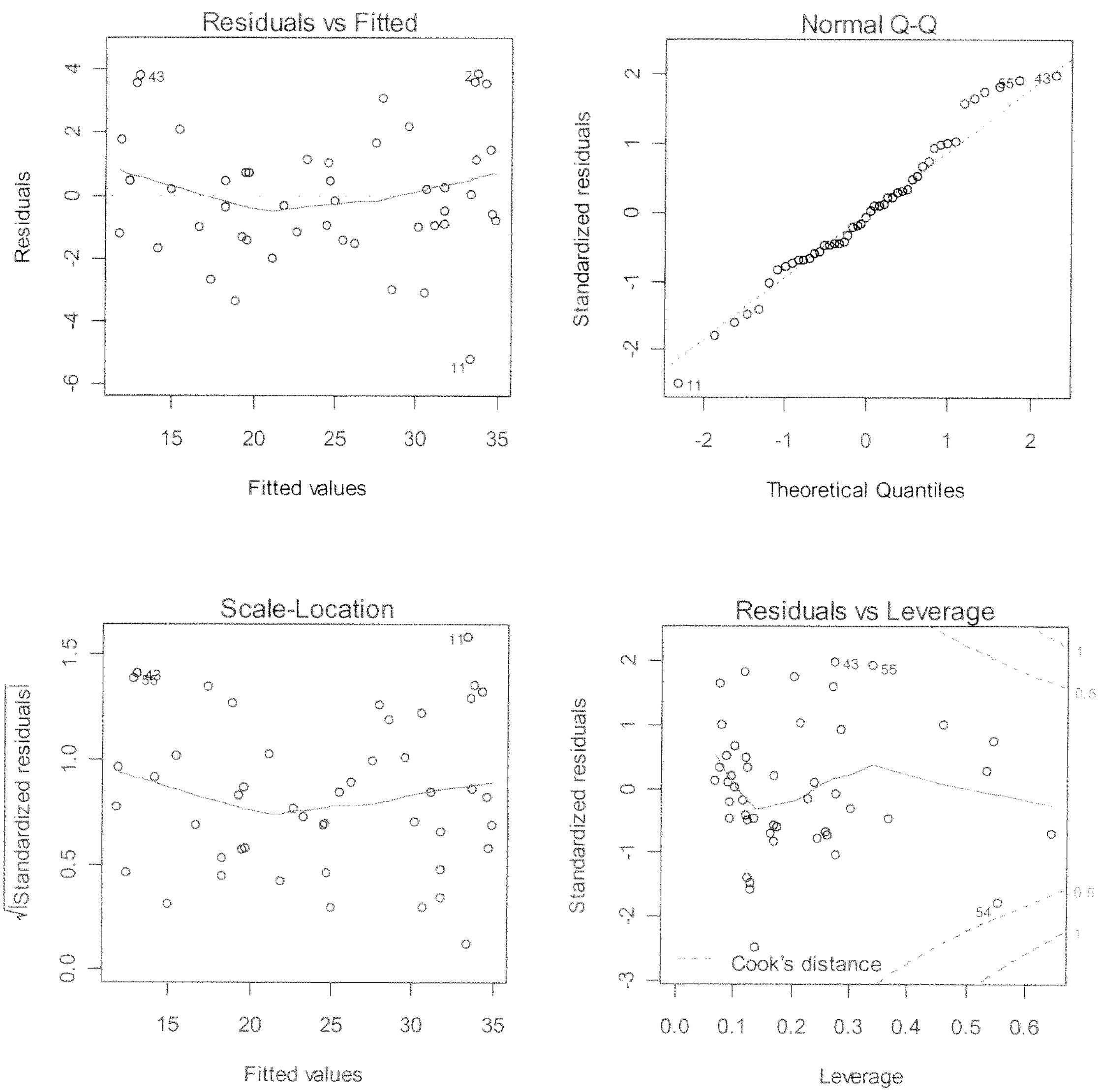
Figure 4: Model Diagnostic Plots for Ni Predicted by Fe, K, Al and Area



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Attachment 2: R Printouts

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Bootstrap Confidence Intervals for Ni

```
Sken.AOC2.Ni.diff.bs$call <-
boot(data = Sken.AOC2.metals[Use, ], statistic = mean.wt.zone.Ni.diff,
    R = 1000, strata = backfill.area[Use], weights = Ni.wt[Use])
```

Note that the lower limit of a 90% two-sided confidence interval (CI) for the mean is also a 95% LCL for the mean.

Area B/C

```
boot.ci(Sken.AOC2.Ni.diff.bs,index=1,conf=0.9,type="perc")
BOOTSTRAP CONFIDENCE INTERVAL CALCULATIONS
Based on 1000 bootstrap replicates

Intervals :
Level     Percentile
90%   (10.75, 16.12 )
Calculations and Intervals on Original Scale
```

Area F

```
boot.ci(Sken.AOC2.Ni.diff.bs,index=2,conf=0.9,type="perc")
BOOTSTRAP CONFIDENCE INTERVAL CALCULATIONS
Based on 1000 bootstrap replicates

Intervals :
Level     Percentile
90%   ( 0.838,  6.961 )
Calculations and Intervals on Original Scale
```

Bootstrap Confidence Intervals for Hg

```
Sken.AOC2.Hg.diff.bs$call <-
boot(data = Sken.AOC2.metals[Use, ], statistic = mean.wt.zone.Hg.diff,
  R = 1000, strata = backfill.area[Use], weights = Hg.wt[Use])
```

Area B/C

```
boot.ci(Sken.AOC2.Hg.diff.bs,index=1,conf=0.9,type="perc")
BOOTSTRAP CONFIDENCE INTERVAL CALCULATIONS
Based on 1000 bootstrap replicates

Intervals :
Level     Percentile
90%   (-0.0292,  0.0109 )
Calculations and Intervals on Original Scale
```

Area F

```
boot.ci(Sken.AOC2.Hg.diff.bs,index=2,conf=0.9,type="perc")
BOOTSTRAP CONFIDENCE INTERVAL CALCULATIONS
Based on 1000 bootstrap replicates
```

```
Intervals :
Level     Percentile
90%    (-0.0287, -0.0074 )
Calculations and Intervals on Original Scale
```

Initial Linear Model with Fe and Area as Predictors

```
>summary(Sken.AOC2.Ni.lm)

Call:
lm(formula = Ni ~ Fe * Area, data = Sken.AOC2.metals, subset = Use)

Residuals:
    Min      1Q  Median      3Q     Max
-6.4720 -2.0780  0.5308  1.8158  6.1220

Coefficients:
                 Estimate Std. Error t value Pr(>|t|)
(Intercept)    -5.767e+00  1.112e+01  -0.519  0.60644
Fe              1.103e-03  3.370e-04   3.274  0.00204 **
AreaArea C     -1.536e+01  1.482e+01  -1.036  0.30569
AreaArea F      9.497e+00  1.152e+01   0.825  0.41395
AreaBG          8.601e+00  1.194e+01   0.720  0.47520
Fe:AreaArea C   4.408e-04  4.453e-04   0.990  0.32751
Fe:AreaArea F  -3.891e-04  3.581e-04  -1.087  0.28297
Fe:AreaBG      -4.083e-04  3.987e-04  -1.024  0.31131
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.958 on 45 degrees of freedom
Multiple R-Squared: 0.8671,     Adjusted R-squared: 0.8464
F-statistic: 41.94 on 7 and 45 DF,  p-value: < 2.2e-16

> Anova(Sken.AOC2.Ni.lm)
Anova Table (Type II tests)

Response: Ni
          Sum Sq Df F value    Pr(>F)
Fe        667.44  1 76.2705 3.028e-11 ***
Area       32.60  3  1.2417    0.3058
Fe:Area    69.94  3  2.6642    0.0592 .
Residuals 393.79 45
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Final Linear Model with Fe Only as Predictor

```
> summary(Sken.AOC2.Ni.lm3)

Call:
lm(formula = Ni ~ Fe, data = Sken.AOC2.metals, subset = Use)

Residuals:
    Min      1Q  Median      3Q     Max
-6.1722 -1.9566  0.5159  2.5084  5.4351
```

```
Coefficients:
                 Estimate Std. Error t value Pr(>|t|)
(Intercept) -2.004e+00  1.787e+00  -1.122    0.267
Fe           9.704e-04  6.096e-05  15.919   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.12 on 51 degrees of freedom
Multiple R-Squared: 0.8325,     Adjusted R-squared: 0.8292
F-statistic: 253.4 on 1 and 51 DF,  p-value: < 2.2e-16

> Anova(Sken.AOC2.Ni.lm3)
Anova Table (Type II tests)

Response: Ni
           Sum Sq Df F value    Pr(>F)
Fe        2466.30  1  253.42 < 2.2e-16 ***
Residuals  496.33 51
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Initial Linear Model with Fe, K, Mg, Al, Area and All Interactions as Predictors

```
> summary(Sken.AOC2.Ni.Fe.K.Mg.Al.lm)

Call:
lm(formula = Ni ~ Fe + K * Area + Mg * Area + Al * Area + Area,
    data = Sken.AOC2.metals, subset = Use)

Residuals:
     Min       1Q   Median       3Q      Max
-4.68800 -0.95048 -0.09436  1.39682  3.67385

Coefficients:
                       Estimate Std. Error t value Pr(>|t|)
(Intercept)          -1.290e+01  9.551e+00  -1.350   0.1870
Fe                    4.385e-04  9.312e-05   4.709 5.29e-05 ***
K                    -3.311e-04  5.229e-03  -0.063   0.9499
Area[T.Area C]       -6.239e+01  4.772e+01  -1.307   0.2010
Area[T.Area F]        1.898e+01  1.491e+01   1.273   0.2127
Area[T.BG]            2.340e+01  1.003e+01   2.334   0.0265 *
Mg                    2.425e-03  1.194e-03   2.031   0.0512 .
Al                    7.729e-04  5.202e-04   1.486   0.1478
K:Area[T.Area C]     -2.273e-02  2.570e-02  -0.884   0.3836
K:Area[T.Area F]      5.660e-03  9.816e-03   0.577   0.5685
K:Area[T.BG]          6.716e-03  5.744e-03   1.169   0.2515
Area[T.Area C]:Mg     6.606e-03  7.112e-03   0.929   0.3604
Area[T.Area F]:Mg    -6.335e-04  2.409e-03  -0.263   0.7944
Area[T.BG]:Mg        -2.243e-03  1.226e-03  -1.829   0.0773 .
Area[T.Area C]:Al     3.708e-03  3.042e-03   1.219   0.2324
Area[T.Area F]:Al    -1.414e-03  6.136e-04  -2.305   0.0283 *
Area[T.BG]:Al        -1.729e-03  6.690e-04  -2.584   0.0149 *
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.234 on 30 degrees of freedom
Multiple R-Squared: 0.9453,     Adjusted R-squared: 0.9162
F-statistic: 32.42 on 16 and 30 DF,  p-value: 1.377e-14

> Anova(Sken.AOC2.Ni.Fe.K.Mg.Al.lm)
Anova Table (Type II tests)

Response: Ni
           Sum Sq Df F value    Pr(>F)
Fe        110.715  1 22.1792 5.285e-05 ***
K          30.236  1  6.0570   0.01982 *
Area       44.340  3  2.9608   0.04800 *
Mg          7.330  1  1.4683   0.23507
Al         15.953  1  3.1959   0.08393 .
K:Area     13.090  3  0.8741   0.46544
Area:Mg    26.332  3  1.7583   0.17639
Area:Al    50.229  3  3.3541   0.03184 *
Residuals 149.755 30
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Final Linear Model with Fe, K, Al, Area and Al:Area as Predictors

```
> summary(Sken.AOC2.Ni.Fe.K.Mg.Al.lm3)

Call:
lm(formula = Ni ~ Fe + K + Al * Area + Area, data = Sken.AOC2.metals,
    subset = Use)

Residuals:
    Min      1Q  Median      3Q     Max
-5.2428 -1.2051 -0.1643  1.1174  3.8753

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)         -9.490e-01  6.557e+00  -0.145   0.8857
Fe                   4.898e-04  8.047e-05   6.087 4.79e-07 ***
K                    8.520e-03  1.226e-03   6.947 3.33e-08 ***
Al                  -4.591e-05  3.524e-04  -0.130   0.8971
Area[T.Area C]      -1.608e+01  1.283e+01  -1.253   0.2179
Area[T.Area F]       1.093e+01  6.784e+00   1.611   0.1157
Area[T.BG]           1.245e+01  7.409e+00   1.680   0.1014
Al:Area[T.Area C]    7.663e-04  7.434e-04   1.031   0.3093
Al:Area[T.Area F]   -7.644e-04  4.121e-04  -1.855   0.0716 .
Al:Area[T.BG]       -1.232e-03  5.128e-04  -2.402   0.0214 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Note: See ANOVA table below where Area is a significant predictor. Area is coded as a factor whose first level is 'Area B'. The factor effects are fitted so that the effect for the first

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level is 0. So the other metals being equal, we estimate that Ni should be about 12 mg/kg higher on average in samples from Area B than in samples from BG.

```
Residual standard error: 2.259 on 37 degrees of freedom
Multiple R-Squared: 0.9311,     Adjusted R-squared: 0.9143
F-statistic: 55.53 on 9 and 37 DF,  p-value: < 2.2e-16

> Anova(Sken.AOC2.Ni.Fe.K.Mg.Al.lm3)
Anova Table (Type II tests)

Response: Ni
           Sum Sq Df F value    Pr(>F)
Fe        189.062  1 37.0535 4.785e-07 ***
K         246.278  1 48.2669 3.331e-08 ***
Al         96.431  1 18.8990 0.0001036 ***
Area       45.269  3  2.9573 0.0448471 *
Al:Area    62.128  3  4.0588 0.0136914 *
Residuals 188.789 37
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

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Attachment 3: Data

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	Area	SampleID	Backfill	backfill.area	Hg	Hg.q	Hg.wt	Ni	Ni.q	Ni.wt	Al	Ca	Fe	K	Mg
1	Area B	EX-B-1	FALSE		0.22		1	30.5		1	16300	4300	33000	1850	6470
2	Area B	EX-B-2	TRUE	B/C	0.05		1	37.7		1	17300	10100	38000	1990	7980
3	Area B	EX-B-3	TRUE	B/C	NA	U	0	30.9		1	15000	16200	33000	1900	8290
4	Area B	EX-B-4	TRUE	B/C	0.023		1	31.3		1	15000	28100	32400	2060	8070
5	Area B	EX-B-5	FALSE		0.2		1	26.4		1	16000	2400	31100	1700	5350
6	Area B	EX-B-6	TRUE	B/C	0.031		1	30.9		1	14600	36700	31700	2100	8440
7	Area B	EX-B-7	TRUE	B/C	0.024		1	27.4		1	17800	922	35000	1780	5920
8	Area B	EX-B-8	TRUE	B/C	0.034		1	31		1	13300	20600	30300	1720	7610
9	Area B	EX-B-9	TRUE	B/C	0.057		1	32		1	15600	20300	33600	1990	8080
10	Area B	EX-B-10	TRUE	B/C	0.03		1	31.7		1	17000	2410	33000	1770	5730
11	Area B	EX-B-11	TRUE	B/C	0.022		1	28.2		1	15100	30600	31100	2330	8760
12	Area B	EX-B-12	TRUE	B/C	0.043		1	23.5		1	16400	1780	30000	1350	4880
13	Area B	EX-B-13	TRUE	B/C	0.036		1	36.1		1	15900	24900	34200	2300	8760
14	Area B	EX-B-14	TRUE	B/C	0.036		0.5	33.4		0.5	15000	24100	33900	2160	7800
15	Area B	EX-B-15	FALSE		0.026		1	33.6		1	17300	3100	34500	2130	5960
16	Area B	EX-B-16	TRUE	B/C	0.042		1	29.2		1	20100	1730	29300	1770	5670
17	Area B	EX-B-DUP	TRUE	B/C	0.035		0.5	37.2		0.5	15800	21900	34800	2140	8340
18	Area B	EX-B-1RE	TRUE	B/C	0.27		1	25.6		1	17500	2150	34300	1590	5400
19	Area B	EX-B-5RE	TRUE	B/C	0.1		1	29.1		1	17800	2510	34000	1790	5500
20	Area B	EX-B-15RE	TRUE	B/C	0.05		1	24.1		1	15000	2240	31000	1410	5100
21	Area C	EX-C-1	FALSE		0.16		0.5	37.8		0.5	18300	6970	37400	2330	7380
22	Area C	EX-C-2	FALSE		0.17		1	37.3		1	18000	24800	44200	2670	7860
23	Area C	EX-C-3	TRUE	B/C	0.03	J	1	24.7		1	18200	1560	31700	1720	4900
24	Area C	EX-C-4	TRUE	B/C	0.045		1	34.1		1	18900	7810	36800	2360	7200
25	Area C	EX-C-5	FALSE		0.033	J	1	30.4		1	17000	20100	33500	2310	7600
26	Area C	EX-C-6	FALSE		0.071		1	27.4		1	17500	2650	31200	1960	5360
27	Area C	EX-C-7	FALSE		0.25		1	33.3		1	19900	2840	37000	2240	6400
28	Area C	EX-C-8	FALSE		0.46		1	33.2		1	18500	2450	34200	2140	5810
29	Area C	EX-C-9	FALSE		0.33		1	36.2		1	18400	9430	41100	2320	6090
30	Area C	EX-C-10	FALSE		0.16		1	34.3		1	16900	11800	33300	2430	7610

	Area	SampleID	Backfill	backfill.area	Hg	Hg.q	Hg.wt	Ni	Ni.q	Ni.wt	Al	Ca	Fe	K	Mg
31	Area C	EX-C-11	TRUE	B/C	0.02	J	1	37.9		1	18100	10600	36900	2380	7600
32	Area C	EX-C-12	TRUE	B/C	0.061		1	34.1		1	19200	6120	36800	2360	6780
33	Area C	EX-C-13	FALSE		0.073		1	31.5		1	18700	2940	36000	1980	6110
34	Area C	EX-C-1RE	FALSE		1.1		1	33.6		1	16300	6840	33300	2060	6830
35	Area C	EX-C-2RE	TRUE	B/C	0.044		1	30.2		1	15400	26700	33100	2450	8740
36	Area C	EX-C-7RE	FALSE		0.13		1	34.4		1	18500	2180	35300	2090	6060
37	Area C	EX-C-8RE	FALSE		0.27		1	34.6		1	16100	8330	34800	2050	7330
38	Area C	EX-C-9RE	FALSE		0.029		1	27.6		1	14000	NA	29300	2380	8330
39	Area C	EX-C-10RE	TRUE	B/C	0.012	U	1	18.8		1	15800	936	27800	1220	4340
40	Area C	EX-C-DUP	FALSE	B/C	0.092		0.5	33.4		0.5	18900	4640	37300	2030	6560
41	Area F	EX-F-1	TRUE	F	0.029	J	1	34.8		1	14400	5690	43700	1640	4640
42	Area F	EX-F-2	TRUE	F	0.03	J	1	25.1		1	15700	17100	27400	1640	4870
43	Area F	EX-F-3	TRUE	F	0.054		1	16.9		1	20200	2530	15900	1370	3400
44	Area F	EX-F-4	TRUE	F	0.035		1	21.5		1	14200	5780	21100	1630	4480
45	Area F	EX-F-5	TRUE	F	0.06		1	19.2		1	13000	3610	18500	1490	3500
46	Area F	EX-F-6	TRUE	F	0.049		1	13.7		1	21200	2210	18200	1200	2730
47	Area F	EX-F-7	TRUE	F	0.043		1	24.4		1	15800	3300	27200	1500	4480
48	Area F	EX-F-8	TRUE	F	0.049		1	25.6		1	14800	4190	27500	1540	4910
49	Area F	EX-F-9	TRUE	F	0.046		1	15.6		1	19200	1940	24200	1490	3750
50	Area F	EX-F-10	TRUE	F	0.072		1	17.9		1	16300	3420	19100	1430	3710
51	Area F	EX-F-11	TRUE	F	0.034	J	1	20.2		1	17100	2360	25300	1290	3470
52	Area F	EX-F-12	TRUE	F	0.037		1	15.7		1	17800	2310	21100	1270	3050
53	Area F	EX-F-13	TRUE	F	0.033	J	1	20.4		1	15000	2310	22400	1280	3570
54	Area F	EX-F-DUP	TRUE	F	0.022	J	0.5	14.7		0.5	22400	1800	35300	974	2610
55	BG	HP10	FALSE	BG	0.059		1	16.4		1	12700	3380	22600	767	3760
56	BG	HP11	FALSE	BG	0.053		1	21.5		1	12200	22600	25300	1590	13100
57	BG	HP12	FALSE	BG	0.086		0.5	18.2		0.5	12800	6050	24800	1450	3740
58	BG	HP112	FALSE	BG	0.095		0.5	18		0.5	12800	5990	25700	1360	3860
59	BG	HP13	FALSE	BG	0.055	J	1	24.8		1	9270	18700	22800	1660	5440
60	BG	HP14	FALSE	BG	0.074		1	17.5		1	7310	21700	16800	592	5040
61	BG	HP15	FALSE	BG	0.084		1	12.9		1	8060	2590	14500	490	2240

	Area	SampleID	Backfill	backfill.area	Hg	Hg.q	Hg.wt	Ni	Ni.q	Ni.wt	Al	Ca	Fe	K	Mg
62	BG	HP16	FALSE	BG	0.039	J	1	10.6		1	8110	1520	14100	443	2150
63	BG	HP17	FALSE	BG	0.054		1	12.5		1	7950	1280	16900	539	2320
64	BG	HP18	FALSE	BG	0.04	J	1	15.2		1	7080	46600	16900	503	5880