GEOCHEMICAL CHARACTERIZATION OF OBSIDIAN SUBSOURCES FROM THE COSO RANGE, CALIFORNIA USING LASER ABLATION INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY AS A TOOL FOR ARCHAEOLOGICAL INVESTIGATIONS

A Thesis
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TO THE OFFICE OF GRADUATE STUDIES AND RESEARCH

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This manuscript has been prepared in accordance with the guidelines for submittal to the Journal of Archaeological Science in order to facilitate publication with as little delay as possible. Therefore, supporting materials have been moved into appendices and the main manuscript has been kept brief.

ABSTRACT

The Coso Volcanic Field in California contains at least 38 high-silica rhyolite domes, many of which contain workable obsidian (Bacon and Duffield, 1981). The area was quarried by the indigenous population for over 12,000 years (Gilreath and Hildebrandt, 1997) and Coso obsidian artifacts are found throughout the southwestern United States. Four separate chemical groups have previously been identified using XRF (Hughes, 1988). Two more were tentatively identified with INAA (Ericson and Glascock, 2004). The four major groups are referred to as West Cactus Peak, West Sugarloaf, Sugarloaf, and Joshua Ridge.

We analyzed more than 250 Coso samples, samples from seven additional eastern California sources, and the new US Geological Survey synthetic basalt-glass standard GSD-1G by ICP-MS with Laser Ablation and after microwave digestion. A total of 25 elements were measured. Stepwise multi-element discriminant analysis shows that 15 of the measured elements are useful for distinguishing Coso subsources and identifies four distinct groups. These groups agree with the previous studies and include samples from the type sites and from a newly identified quarry, the Stewart Quarry. The newly identified quarry is chemically identical to the West Cactus Peak subsource, but is located much farther south in the Coso Volcanic Field, indicating that further discussion is needed for interpretation of subsource use based on geography. All seven other eastern California sources are easily distinguishable from Coso samples and from each other. These results demonstrate that Laser Ablation ICP-MS is a viable alternative for the analysis of obsidian artifacts in the Western United States. Laser Ablation ICP-MS is inexpensive, rapid, and minimally destructive, requiring little or no sample preparation or cleaning. Our analysis of GSD-1G is similar to published analyses and also demonstrates the suitability of this standard for Laser Ablation ICP-MS studies of obsidian. The GSD-1G standard is a synthetic basalt glass more similar to obsidian than the NIST standards commonly used in such studies.

Geochemical Characterization of Obsidian Subsources from the Coso Range, California Using Laser Ablation Inductively Coupled Plasma Mass Spectrometry as a Tool for Archaeological Investigations

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1. Introduction

Obsidian is a naturally occurring volcanic glass that was used throughout prehistory for manufacturing tools. Obsidian sources are not common; as a result, material was often traded or otherwise transported far from its original geologic source. Determining the source of an artifact can be useful for reconstructing movements and political relationships between groups of prehistoric people and for determining more accurate age dates of artifacts (e.g. Eerkens and Rosenthal, 2004). Previous provenance studies have primarily used X-Ray Fluorescence (XRF) (Hughes, 1988), Instrumental Neutron Activation Analysis (INAA) (Ericson and Glascock, 2004), and Particle Induced X-Ray Emission (PIXE) (Bugoi et al., 2004; Bellot-Gurlet et al., 2005). Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) is emerging as a potential alternative to these methods. LA-ICP-MS sampling is simple, inexpensive, rapid, and minimally destructive, potentially making it an extremely powerful tool for archaeological investigations. Additionally, because it affects only a small area of the surface, and no washing or cleaning needs to be done on the sample being analyzed, artifacts can still be residue tested (i.e. protein, fats).

LA-ICP-MS has been used to successfully source obsidian from Hungary/Slovakia and from the Mediterranean (Bugoi et al., 2004; Gratuze, 1999), to characterize volcanic tephra (Baron et al., in press: Golob, 2005; Westgate et al., 1994; Pierce et al., 1996; Pierce et al., 2002), and to chemically characterize a variety of other archaeological material such as ceramics and glass (Shortland et al., 2007; James et al., 2005).

This study applies LA-ICP-MS to obsidian from different sources in California (Figure 1) including the Coso Volcanic Field. As the Coso Volcanic Field (CVF) was a major source of tool-stone material in California for more than 12,000 years (Gilreath and Hildebrant, 1997), we also investigated whether LA-ICP-MS can be used to distinguish subsources from the Coso Volcanic Field in California (Figure 1, Figure 2). Because the Coso subsources vary in their accessibility, quality, proximity to permanent settlements, and attainability (i.e. surface scavenging vs. mining), it has been shown that usage trends vary significantly (Eerkens and Rosenthal, 2004).

The adoption of LA-ICP-MS studies as a widespread tool for archaeological analysis has been impeded by the lack of an appropriate standard (James et al., 2005; Gratuze, 1999). This study includes the analysis of the newly available synthetic basalt glass standard GSD-1G from the US Geological Survey, and a discussion of its utility for archaeological studies. The GSD-1G standard is available as both solid glass chips and powder. The chips were used in the Laser Ablation ICP-MS analysis, and both the powder and pulverized chips were analyzed by ICP-MS after microwave digestion.

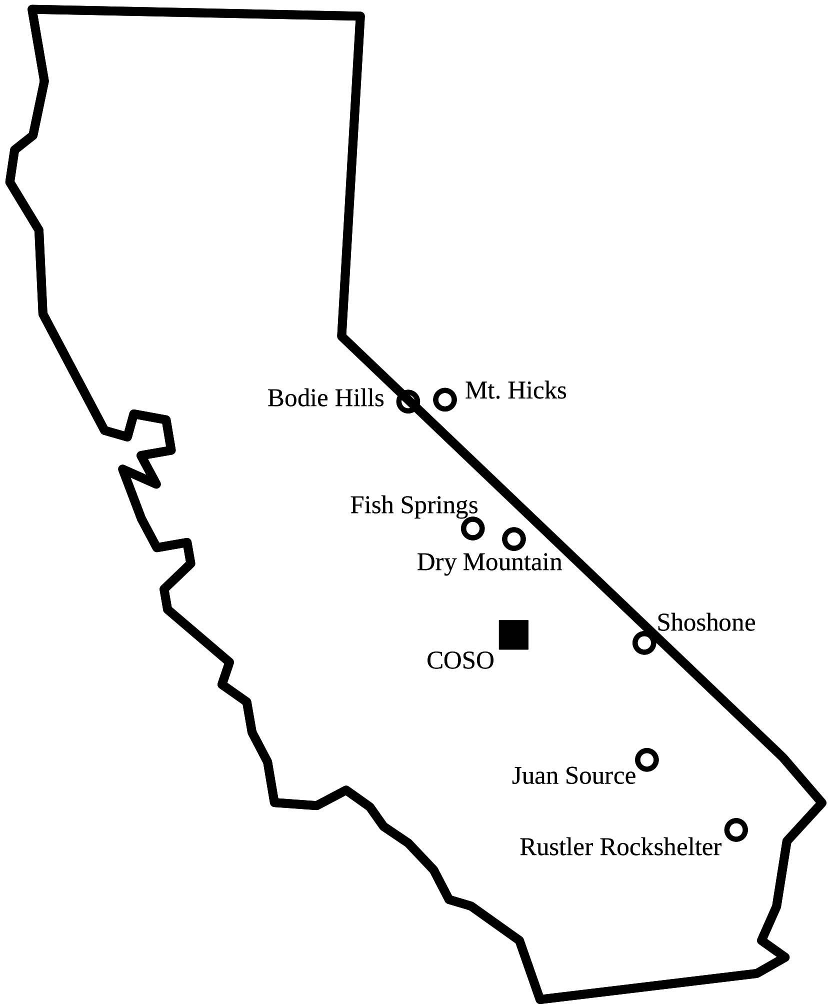

Figure 1: Map of California, showing obsidian sources analyzed in this study.

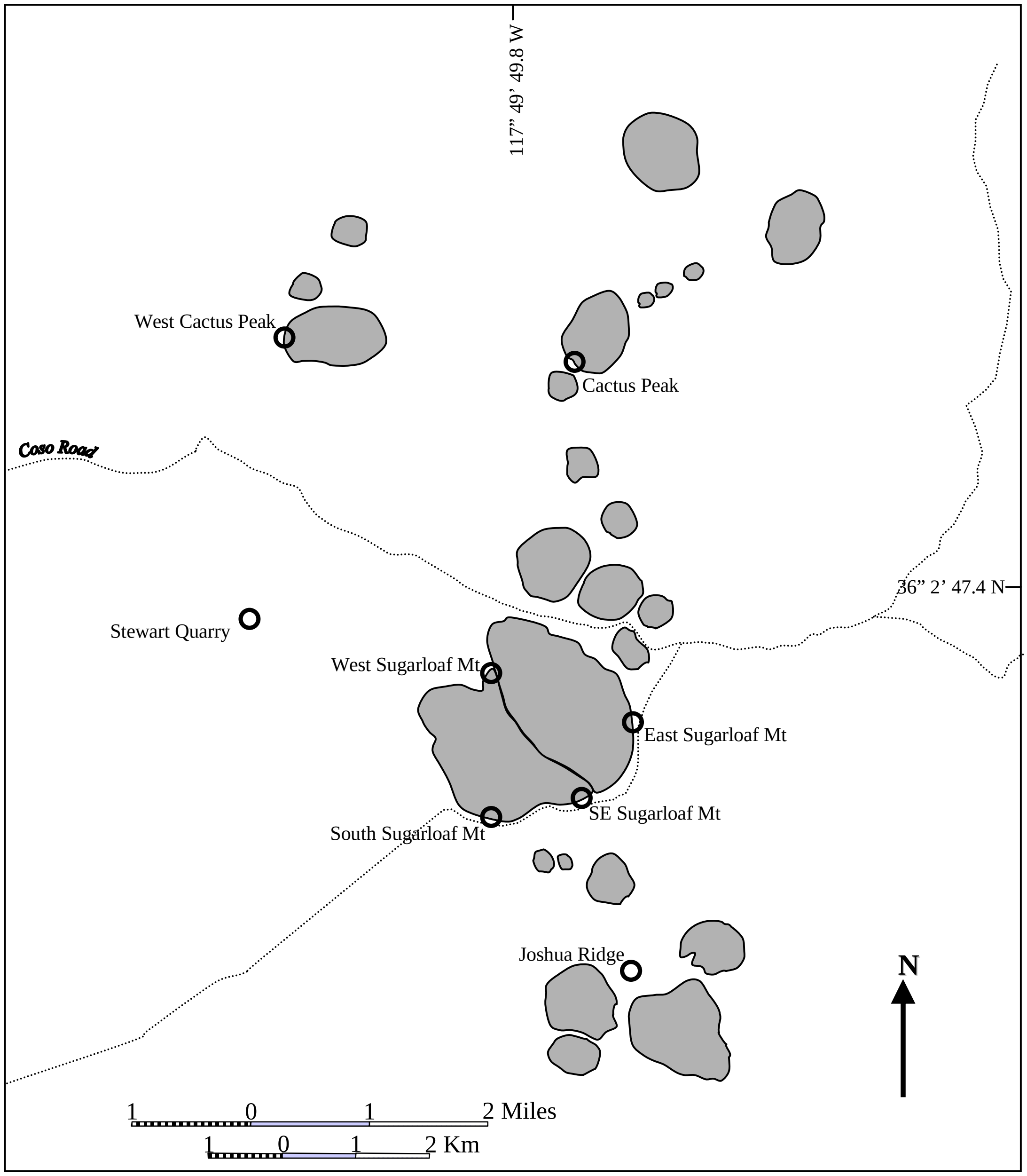

Figure 2: Map of Coso Volcanic Field with locations of sample collection sites. After Hughes (1988).

2. Background

2.1 Geologic Setting

The Coso Volcanic Field (CVF) contains a spectrum of igneous rock types and compositions, ranging from basalt to rhyolite. The volcanics that are the focus of this study are underlain by Mesozoic plutons and metamorphics and were primarily emplaced during Cenozoic extension (Duffield et al., 1980). Rhyolite containing obsidian is present as domes and flows. At least 38 separate domes have been identified (Bacon and Duffield, 1980). Workable obsidian is present in many of the domes (Duffield et al., 1980). Most domes were formed between 300,000 and 60,000 years ago. Because of this geologically young age, many of the domes are not eroded enough to expose any obsidian, which is typically present on the interior of the dome (Duffield et al., 1980). However, small obsidian pebbles are found across the Coso Volcanic Field landscape, having been explosively expelled as part of the dome emplacement process (Duffield et al., 1980). Coso rhyolite and obsidian is typically 77% SiO_2 by weight (Duffield et al., 1980). The area is also geothermally and seismically active. Age dates and geochemical profiles of the rhyolite have been obtained on the domes and flows in order to profile the magma evolution and better understand the geothermal energy potential. Such studies have identified seven chemical groups of rhyolite (Bacon et al., 1981).

From an archaeological perspective, uneroded rhyolite domes cannot be tool-stone sources and are therefore not significant for a study of this kind. Four archaeologically significant chemical groups of obsidian have been conclusively identified by other methods, namely X-Ray Fluorescence (XRF) and Instrumental Neutron Activation Analysis (INAA), and two more groups have been postulated based on INAA results (Hughes, 1988; Ericson and Glascock, 2004). The four well-defined groups are associated with specific rhyolite domes or quarries and are referred to as the West Cactus Peak, Joshua Ridge, Sugarloaf Mountain, and West Sugarloaf Mountain sources (Figure 2).

2.2 Archaeological Setting-Coso Volcanic Field

Eastern California contains several significant sources of workable obsidian that were exploited by the prehistoric population. Coso Volcanic Field was one of the most important of these, containing at least 150 separate quarries. The quarries vary in obsidian quality, accessibility, and proximity to other natural resources and thus were active for different purposes at different times (Gilreath and Hildebrant, 1997). For example, the Coso field was actively quarried both before and after the arrival of the bow and arrow ~1500 years ago, for both local and trade use (Yohe, 1998). Coso obsidian appears to have been extensively traded and has been found all over the American Southwest (Gilreath and Hildebrant, 1997). Prehistoric people took advantage of both primary and lag deposits of obsidian (Eerkins and Rosenthal, 2004).

2.3 Previous Work on Characterization of Obsidian from Coso Volcanic Field

Extensive geologic and archaeological work has been done in the Coso Volcanic Field area. Geologic mapping and geochemical studies were conducted in the 1970-80s (Duffield et al., 1980; Bacon and Duffield, 1980; Bacon et al., 1981), and the archaeology has been studied in depth since the 1950's with important studies more recently (Gilreath and Hildebrant, 1997). The presence of significant quarries has been known since the 1930's

(Gilreath and Hildebrant, 1997), and the first significant geochemical study of the obsidian subsources was conducted in 1988 with X-Ray Fluorescence (Hughes, 1988). The Hughes study was able to distinguish between four subsources using a simple Zr-Rb bivariate plot. The subsources identified were Sugarloaf Mountain, West Sugarloaf Mountain, West Cactus Peak, and Joshua Ridge (Figure 2). Hughes (1988) specifically raises the possibility that more tool-stone quality sources may remain to be identified. A subsequent study (Bouey, 1991) raised the possibility that XRF may not be the most suitable method for the sourcing of archaeological material, because surface irregularities such as those common in flaked stone may cause measurement errors. Bouey (1991) also suggested that the Sugarloaf Mountain and West Sugarloaf subsources might not be as readily distinguishable as suggested by Hughes (1988). However, a more recent study using INAA confirmed the four subsources identified by Hughes and added the possibility of 2 more subsources (Ericson and Glascock, 2004).

2.4 Previous Applications of LA-ICP-MS

LA-ICP-MS has been applied to obsidian in the Mediterranean (Gratuze, 1999) and to the analysis of glass shards found in tephra (Baron et al., in press; Golob, 2005; Westgate et al., 1994; Pierce et al., 1996; Pierce et al., 2002). LA-ICP-MS has also been applied to other archaeological material such as ceramics (Shortland et al., 2007; James et al., 2005) and biological materials such as benthic foraminifer (Wu and Hillaire-Marcel, 1995).

3. Methods

3.1 Sample Collection

A selection of Eastern California/Western Nevada samples was provided by Dr. Yohe of the CSU Bakersfield Department of Sociology and Anthropology. The locations of these samples are shown in Figure 1.

Coso obsidian samples were collected on three separate trips to the Coso Volcanic Field. Access to the area is restricted since it is within the boundaries of the China Lake Naval Air Weapons Station. Most of the samples were collected in 2002. GPS readings were taken at every collection site. More samples were collected in 2004 while on a CSUB Archaeological Lithic Technology Class field trip, and in 2007. The 2002 samples were taken at or directly down slope from obsidian outcrops and quarries. Removal of archaeological material is not permitted, so no broken pieces were collected. All samples are either from outcrop or unbroken cobbles, which are abundant. Several pieces were collected directly from an outcrop of non-tool-stone quality obsidian on Sugarloaf Mountain to check for intra-flow variation. The 2004 samples are not from near an outcrop, but were collected at a newly identified site (the Stewart Quarry) in a canyon to the west of all the major obsidian subsources. The 2007 samples were collected from lag deposits on two domes in order to include all previously identified subsources in this study. All samples were individually rinsed in nanopure water, bagged, and labeled in the lab. Sample locations (Figure 2) are West Sugarloaf Mountain, Southeast (SE) Sugarloaf Mountain, South Sugarloaf Mountain, East Sugarloaf Mountain, Joshua Ridge, Cactus Peak, West Cactus Peak, and the Stewart Quarry.

3.2 LA-ICP-MS Analysis

Samples were reduced or flaked in the lab to obtain a fresh, flat, non-cortical surface of a suitable size to fit in the Laser Ablation sample chamber. 308 samples were analyzed, using a Cetac LS-200 Plus Laser Ablation System with a 266nm Nd:YAG laser attached to a Perkin Elmer Sciex ELAN 6100 Inductively Coupled Plasma Mass Spectrometer.

A suitable surface with no visible irregularities or impurities was identified on each sample. A preliminary line was ablated from this surface at C=3.0 mJ/pulse (50% power), 250μm wide. This was monitored to assure the line was not interrupted by any surface irregularities and that a consistent amount was being ablated. The preliminary line also removed any possible surface contamination and smoothed the surface further. After the preliminary line, the samples were allowed to rest for one minute to allow any debris in the sample chamber to settle. One minute is twice the amount of time it took for the signal to return to baseline after ablation stopped in a sampling run (Figure 3). After one minute, data collection from the ICP/MS was started and allowed to run for at least 5 replicate measurements for each element to ensure that the baseline signal is consistent. This took about 30 seconds, followed by the laser being fired. A 200μm wide line was ablated at C=6.0 mJ/pulse (100% power) inside the trace of the first line. Both the preliminary and sampling laser runs lasted about 30 seconds. This time represents an ablation distance of ~3 mm. The ICP/MS data was collected for approximately 2 minutes, allowing the initial baseline measurement, the measurements during ablation, and a return to baseline (Table 1 and Figure 3). We measured a total of 25 elements (Table 2).

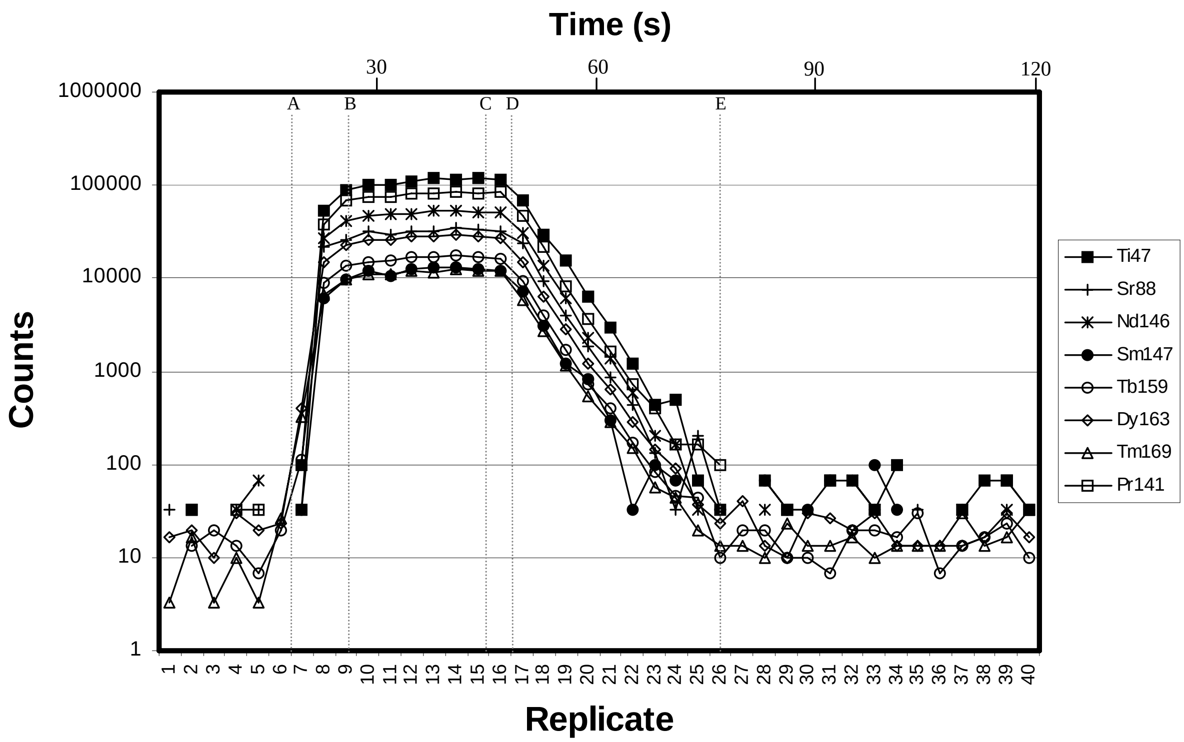

Figure 3: Example of ICP-MS data recorded during a laser ablation sampling run.

0-A: No ablation, background levels recorded.
A: Ablation begins
A-B: Signal ramps up and levels off as ablated material reaches the ICP-MS.
B: Consistent amount of sample is reaching ICP-MS.
B-C: This data is averaged and converted to ppm.
C-D: Ablation ends and signal begins to decay.
D-E: Signal returns to baseline as remainder of ablated material is processed.
E: Baseline is reached.

Table 1: Parameters for the Inductively Coupled Plasma Mass Spectrometer and Laser Ablation System for LA-ICP-MS analysis

	Sampling Run
ICP-MS System	Perkin Elmer Sciex ELAN 6100
Dwell Time-Major Elements (msec)	10
Dwell Time-Minor Elements (msec)	100
No. of Sweeps	3
No. of Readings	1
No. of Replicates	40
Sampling Time (min:s)	02:16.2
Detector Mode	Dual
Acquisition Mode	Peak Hopping

	Cleaning Run	**Sampling Run**
Laser Ablation System	Cetac LS-200 Plus	
Power	50%	100%
Pulse Energy	3 mJ	6 mJ
Line Length (mm)	3mm	3mm
Time (s)	~30 seconds	~30 seconds
Spot Diameter (μm)	250 μm	200 μm
Pulse Repetition Rate (Hz)	20 Hz	20 Hz
Ablation Method	Single Line Scan	Single Line Scan
Laser Wavelength	266 nm	266 nm

Table 2: Isotopes and dwell times used in LA-ICP-MS analysis.

Element	Isotope	Dwell Time (msec)
Ba	137	10
Ce	140	10
Dy	163	100
Er	166	100
Eu	153	100
Fe	57	10
Ga	69	10
Gd	158	10
Ho	165	10
Lu	175	100
Mn	55	10
Nb	93	10
Nd	146	10
Pr	141	10
Rb	85	10
Si	30	10
Sm	147	10
Sr	88	10
Tb	159	100
Ti	47	10
Tm	169	100
Y	89	10
Yb	172	100
Zn	66	100
Zr	90	10

The United States Geological Survey (USGS) synthetic basalt glass standard GSD-1G (Wilson, 2004) was analyzed between every five samples for standardization. Data from LA-ICP-MS was converted to parts per million (ppm) with an element-by-element correction factor derived for each sample using a scaled linear conversion between adjacent USGS GSD-1G standard runs (See Appendix B). The GSD-1G standard was used instead of a NIST glass standard due to the optical similarity to obsidian and available previous analysis of all elements used for the present study (Jochum et al., 2005). Data was plotted on a variety of two-element scatter plots to look for variation and separation between the sources. Discriminant analysis was also conducted on the data from samples from the Coso Volcanic Field. The standard was run multiple times on each day, and again a few months later to analyze for consistency and reproducibility.

3.3 ICP-MS Analysis after Microwave Digestion

Twenty-seven samples were selected for further analysis. Samples were chosen based on availability of appropriate size and quality, i.e. those free of inclusions, those with no visible disparity of appearance, and those whose laser analysis fell within that group's normal distribution. Non-cortical pieces were rinsed in nanopure water, pulverized, and 0.1g±0.005g of the powder was weighed out. Powdered samples were then dissolved in an Anton Paar Multiwave Microwave Digester according to EPA method 3052 (EPA, 1996) (See Appendix D), using Omni*Trace*® Nitric Acid (EMD Science), and Omni*Trace*® Hydrofluoric Acid (EMD Science). These digested samples were diluted with nanopure water (18.3 megaohms-cm) and analyzed for 25 elements using the ELAN 6100 with a

Perkin Elmer AS 93 Plus Autosampler for liquid sample introduction. Samples included several of the Coso subsources, three of the Eastern California locations, the powdered form of the GSD-1G standard, and a piece of the standard that was pulverized by us. The samples are listed in Table 3. Data was corrected for machine drift using a scaled linear conversion derived from multiple runs of standards (See Appendix E). The data was then plotted on a number of two-element scatter plots to look for variation and grouping of the subsources and of the Eastern California sources.

Table 3: Samples used in ICP-MS analysis after microwave digestion.

Sample
WestSugar4-M
WestSugar1-O
WestSugar2-R
WestSugar3-I
JoshuaRidge-R
JoshuaRidge-T
JoshuaRidgeB-J
JoshuaRidgeB-L
JoshuaRidge-O
SouthSugar1-L
SouthSugar2-L
SouthSugar3a-N
SouthSugar3b-I
SESugar1-O
SESugar1-V
SESugar2-L
SESugar2-F
SouthStewart-M
NorthStewart-J
SouthStewart-K
SouthStewart-L
Cactus1-J
Cactus1-L
Cactus2-T
BodieHills
Mt Hicks
Shoshone
GSD-1G pulv.
GSD-1G powder
Acid Blank

4. Results

4.1 LA-ICP-MS Results

Laser Ablation results were collated (Table 4) and analyzed with bivariate plots and discriminant analysis. Discriminant function coefficients can be found in Appendix F. Eastern California sources are readily distinguishable on various two-element plots (Figure 4). Four Coso subsources are distinguishable using bivariate plots as well (Figure 5). Using bivariate plots; all collection sites on the West Sugarloaf dome (West Sugarloaf, SE Sugarloaf, South Sugarloaf) group together, the East Sugarloaf site groups with the Cactus Peak site, and the West Cactus Peak site groups with the Stewart Quarry. Stepwise discriminant analysis using SPSS software (SPSS Inc., 2006) demonstrates a clear grouping of collection sites into chemical subgroups using 16 elements (Figure 6), and a subsequent stepwise discriminant analysis of those subgroups identifies 15 elements most useful for positive subgroup identification (Figure 7).

4.2 ICP-MS from Microwave Digestion Results

Microwave digestion results were collated (Table 5) and analyzed with bivariate plots. Absolute (ppm) data varies from LA-ICP-MS data, but demonstrates the same separation of subgroups. The Cactus Peak, West Sugarloaf, Stewart Quarry, and Joshua Ridge collection sites, representing all four previously identified chemical subgroups, are distinguishable after digestion. Data from digestion suggests that SE Sugarloaf is somewhat more distinct from the West and South Sugarloaf collection sites than is detectable by LA-ICP-MS, but still demonstrates overlap with West Sugarloaf (Figure 8).

Table 4: Results of Laser Ablation Analysis of obsidian from Coso subsources

	West Sugarloaf	South Sugarloaf	SE Sugarloaf	Joshua Ridge	Stewart Quarry	Cactus Peak	East Sugarloaf	West Cactus
N=	*61*	*55*	*48*	*9*	*17*	*33*	*10*	*10*
Ba	47.9±7.1	57.4±13.0	46.9±3.5	68.4±5.4	3.8±0.3	17.5±11.4	26.1±3.8	5.2±0.6
Ce	103.1±5.5	106.2±7.1	103.5±5.3	136±10	75.5±4.9	67.6±4.1	73.6±7.0	76.0±7.2
Dy	8.2±0.5	8.1±0.8	8.5±0.8	7.59±0.84	13.2±1.1	7.9±0.6	8.2±0.8	13.8±2.0
Er	4.7±0.3	4.6±0.4	4.8±0.4	4.17±0.48	7.3±0.6	4.6±0.4	4.8±0.7	7.7±1.0
Eu	0.12±0.01	0.13±0.02	0.12±0.01	0.19±0.02	0.027±0.002	0.08±0.01	0.11±0.01	0.03±0.01
Fe	11393±425	11156±551	11535±564	12667±685	11425±541	10297±496	10540±789	13965±2147
Ga	57.2±3.8	56.4±3.6	58.2±4.2	52.1±3.2	74.1±7.0	56.0±3.2	60.7±4.4	89.6±13.4
Gd	7.1±0.4	7.2±0.6	7.4±0.6	7.31±0.79	11.2±0.8	6.8±0.6	7.0±0.7	11.8±1.7
Ho	1.61±0.12	1.59±0.16	1.67±0.16	1.48±0.17	2.57±0.23	1.56±0.13	1.64±0.19	2.69±0.38
Lu	0.65±0.05	0.64±0.07	0.67±0.07	0.56±0.06	0.97±0.08	0.63±0.05	0.70±0.15	1.01±0.14
Mn	531±38	512±19	527±23	510±30	544±23	571±27.6	543±37	581±69
Nb	106±4	103±6	107±4	87±5	166±12	104±4	99±9	174±20
Nd	31.5±2.1	32.3±2.7	32.5±2.7	40±4	32.5±2.6	24.8±1.9	26.6±3.0	33.1±4.7
Pr	9.0±0.6	9.3±0.7	9.2±0.6	11.8±1.16	8.1±0.7	6.6±0.5	7.1±0.7	8.3±1.1
Rb	285±25	288±27	293±30	212±10	403±45	271±16	272±23	440±50
Sm	7.5±0.5	7.5±0.6	7.7±0.7	8.25±0.91	10.5±0.8	6.7±0.5	6.9±0.7	10.9±1.5
Sr	8.6±1.2	9.6±1.7	8.6±0.7	11.2±0.9	2.2±0.3	4.5±0.9	6.4±0.8	2.4±0.3
Tb	1.3±0.1	1.3±0.1	1.3±0.1	1.21±0.13	2.0±0.2	1.2±0.1	1.3±0.1	2.1±0.3
Ti	763±46	786±56	753±30	968±62	568±28	607±27	621±64	609±65
Tm	0.73±0.05	0.72±0.07	0.75±0.07	0.64±0.07	1.10±0.09	0.70±0.06	0.75±0.12	1.15±0.16
Y	32.3±2.1	31.8±2.9	33.5±2.9	28.9±3.3	50.2±4.1	31.7±2.5	33.0±3.7	52.8±7.9
Yb	5.0±0.4	4.9±0.5	5.1±0.5	4.28±0.45	7.4±0.7	4.8±0.4	5.2±0.9	7.6±1.1
Zn	276±24	275±30	301±34	271±30	400±45	270±29	290±29	465±97
Zr	334±20	350±30	340±28	396±40	361±74	274±22	299±37	360±49

** All data in PPM, showing one standard deviation*

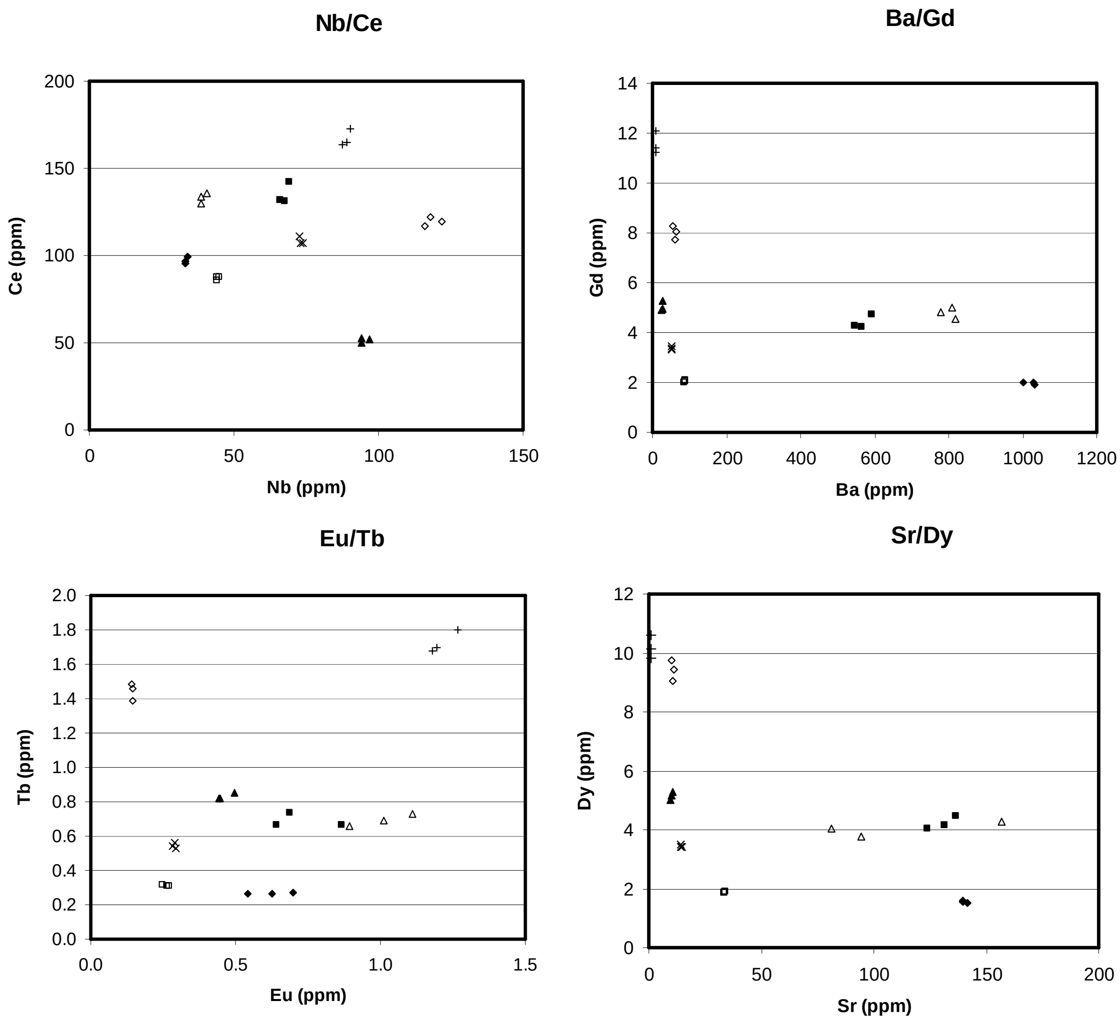

Figure 4: Selected bivariate plots showing distinction between a selection of Eastern California/Western Nevada obsidians with data from Laser Ablation ICP-MS analysis. All sources tested are easily distinguishable with 2-element ratios/plots. See Figure 1 for sample locations.

(♦)Bodie Hills, (■)Dry Mountain, (▲)Fish Springs, (×)Juan Source, (□)Mt. Hicks

(+)Rustler Rockshelter, (Δ)Shoshone, (◊)Coso (West Sugarloaf)

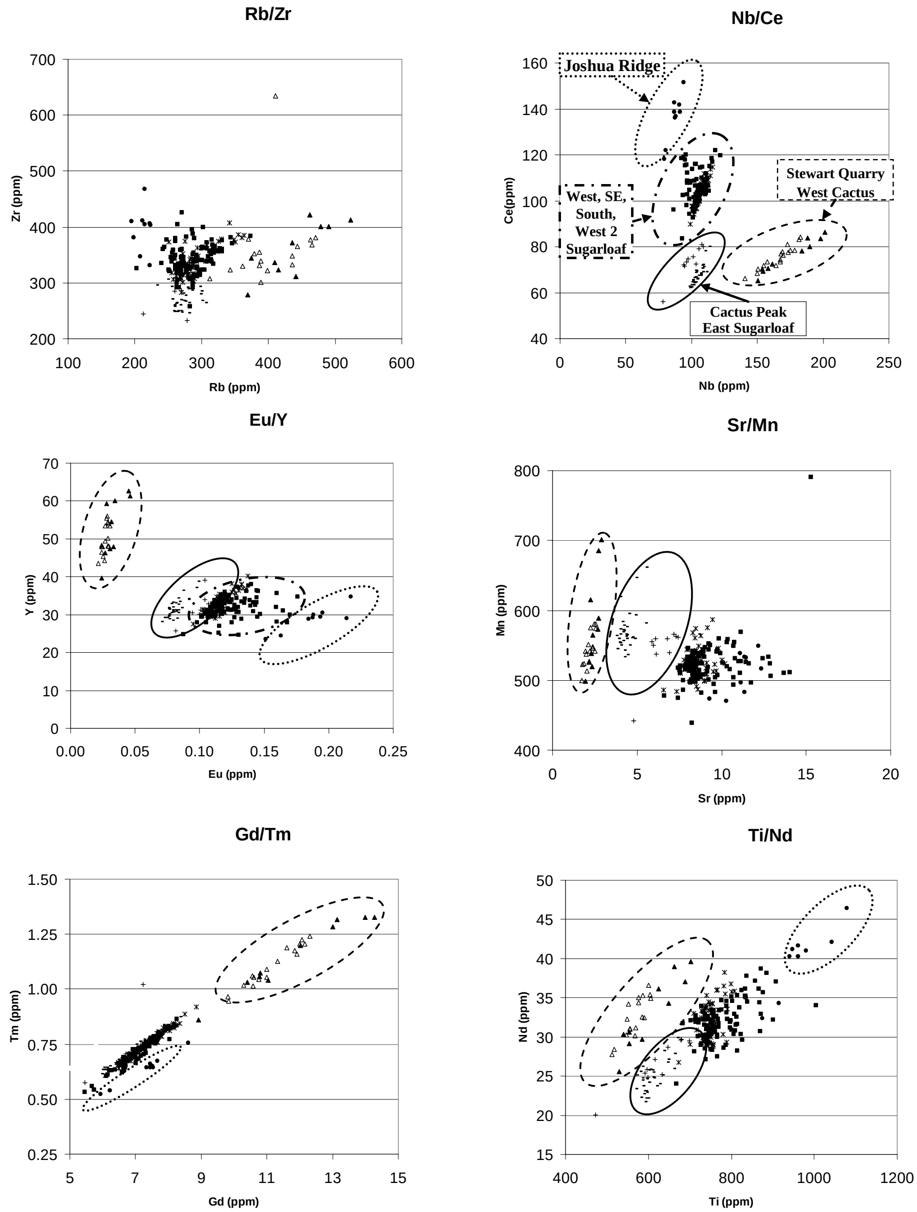

Figure 5: Selected bivariate two-element plots showing Laser Ablation ICP-MS analysis of Coso subsources.

Rb/Zr is not successful at separating any subsources with LA-ICP-MS data. A Nb/Ce ratio can distinguish Joshua Ridge, Sugarloaf, East Sugarloaf/Cactus Peak, and the Stewart Quarry/West Cactus Peak.

(●)Joshua Ridge, (Δ)Stewart Quarry, (▲)West Cactus Peak, (X)SE Sugarloaf Mt., (■)West Sugarloaf Mt., (+)East Sugarloaf, (-)Cactus Peak.

Canonical Discriminant Functions

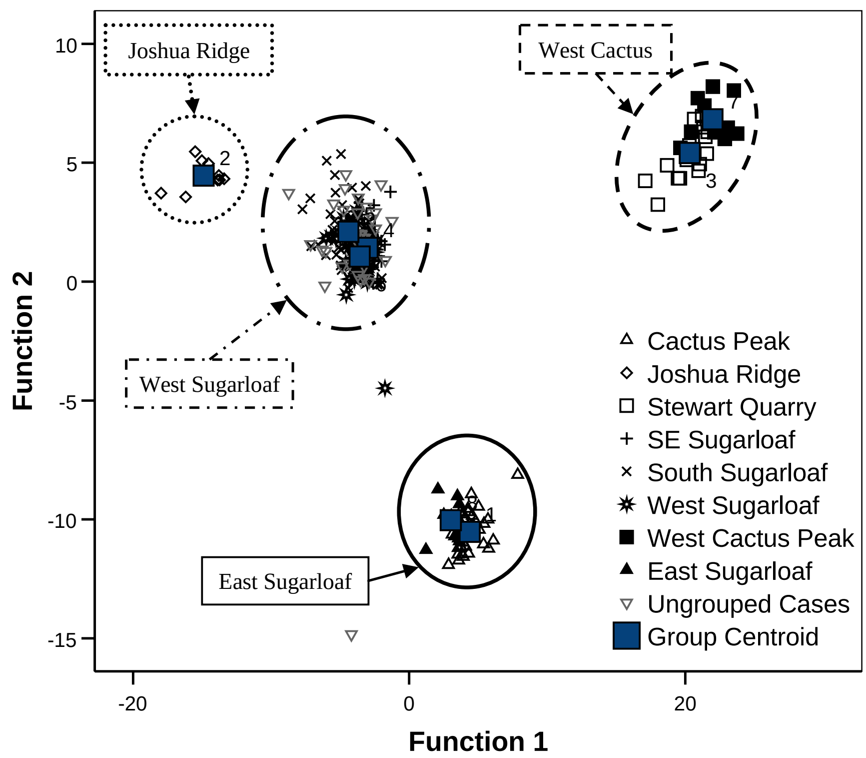

Figure 6: Discriminant analysis of Coso Obsidian based on 16 elements (Nb, Ce, Eu, Sr, Mn, Fe, Ti, Ba, Pr, Gd, Y, Nd, Rb, Zn, Ga, and Sm) (in order of significance for separation of groups) using data from Laser Ablation ICP-MS analysis. Each collection site was treated independently in order not to introduce artificial or biased grouping. See Appendix F for SPSS output.

Canonical Discriminant Functions

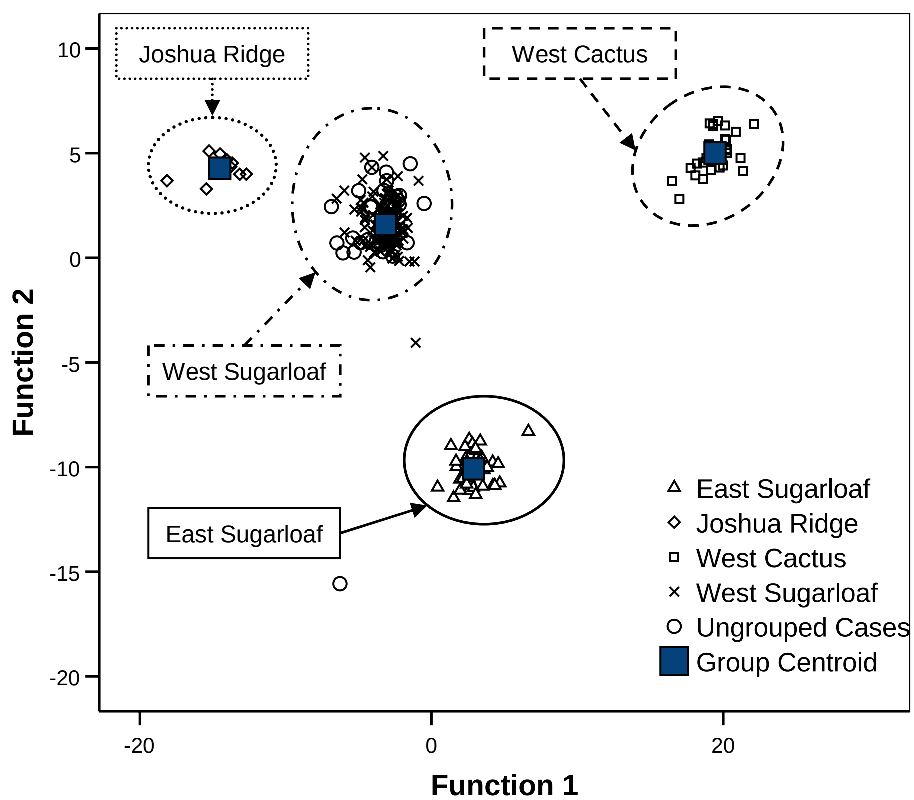

Figure 7: Discriminant analysis of Coso Obsidian based on Nb, Ce, Eu, Sr, Ti, Mn, Zn, Rb, Pr, Sm, Y, Gd, Fe, Ga, and Nd (in order of significance for separation of groups) using data from Laser Ablation analysis. Samples were grouped by chemical subgroup as defined in the previous analysis (see Figure 6) in order to identify elements most useful in distinguishing Coso subsources. See Appendix F for SPSS output.

Table 5: Results of ICP-MS analysis after microwave digestion of obsidian from Coso subsources

	West Sugarloaf	SE Sugarloaf	Joshua	Stewart	Cactus
N=	*8*	*4*	*2*	*4*	*3*
Ba	28.56±7.45	17.83±3.07	34.8±8.2	3.67±0.39	7.42±0.62
Ce	32.0±10.1	17.4±6.6	49.2±24.4	14.1±4.5	13.4±0.9
Dy	4.38±1.18	2.60±0.76	4.51±2.1	4.17±1.29	2.78±0.13
Er	2.83±0.86	1.67±0.52	2.84±1.40	2.58±0.79	1.77±0.07
Eu	0.09±0.04	0.05±0.02	0.12±0.07	0.03±0.01	0.05±0.01
Fe	7293±471	6687±253	7198±531	6428±159	5535±155
Ga	26.30±1.13	23.74±0.66	24.9±1.5	27.19±0.89	22.76±0.16
Gd	3.81±1.11	2.19±0.69	4.64±2.27	3.23±0.96	2.25±0.12
Ho	0.93±0.33	0.53±0.16	0.92±0.48	0.85±0.25	0.57±0.03
Lu	0.51±0.23	0.29±0.09	0.46±0.24	0.43±0.12	0.31±0.02
Mn	221±17	180±15	212±32	187±18	207±4
Nb	54.32±7.14	48.13±1.82	39.9±3.5	70.52±0.95	55.07±8.06
Nd	12.06±3.33	6.93±2.22	17.3±9.1	7.22±2.23	5.97±0.27
Pr	3.22±1.00	1.74±0.54	4.73±2.51	1.63±0.48	1.42±0.06
Rb	231±22	202±9	185±26	258±11	189±1
Sm	3.22±0.85	1.88±0.59	3.93±1.82	2.64±0.77	1.89±0.08
Sr	17.56±3.22	13.32±0.81	18.5±10.0	11.44±1.25	10.42±1.23
Tb	0.68±0.24	0.39±0.12	0.73±0.36	0.62±0.17	0.41±0.02
Ti	413±34	357±10	455±48	275±9	341±59
Tm	0.48±0.19	0.28±0.09	0.45±0.24	0.41±0.11	0.29±0.01
Y	15.83±6.39	8.48±2.90	18.4±12.0	13.11±4.22	9.13±0.40
Yb	3.30±0.94	2.02±0.60	3.10±1.45	3.01±0.90	2.13±0.06
Zn	55.10±2.44	47.91±1.21	54.4±5.2	59.45±1.79	45.70±0.45
Zr	230±17	215±7	239±17	192±4	203±27

** All data in PPM, showing one standard deviation*

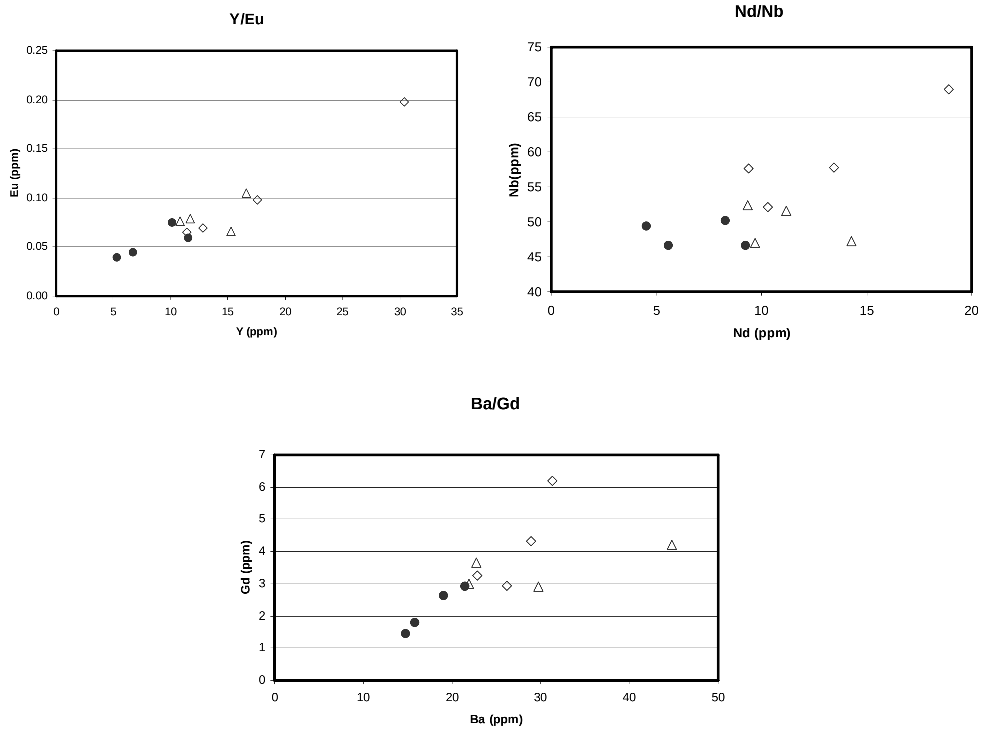

Figure 8: Selected bivariate two-element plots of SE Sugarloaf, South Sugarloaf, and West Sugarloaf collection sites from ICP-MS analyses after microwave digestion. Total dissolution analyses show that the variation in obsidian from quarries on the West Sugarloaf rhyolite dome allows the quarries to be loosely grouped, suggesting some predictable intra-flow variation.

(○)West Sugarloaf, (Δ)South Sugarloaf, (●)SE Sugarloaf

4.3 Replicate Analysis Results

The USGS GSD-1G synthetic basalt glass standard was run fifty-three times during the course of this study, over a time span of several months. Data from all 53 analyses shows a linear trending variation consistent with normal machine drift, and does not contain nonlinear variation that could be attributed to heterogeneity of the standard or that would point towards a process introduced error (Figure 9).

Additionally, two samples, one powder and one solid piece pulverized by us, were analyzed by ICP-MS after microwave digestion. The data was analyzed with bivariate plots and compared to analyses by the USGS and also to a previous published analysis (Jochum et al., 2005). Data for most elements analyzed in this study fell within or very close to the previously published ranges, with the notable exceptions of Rb and Zr (Table 6).

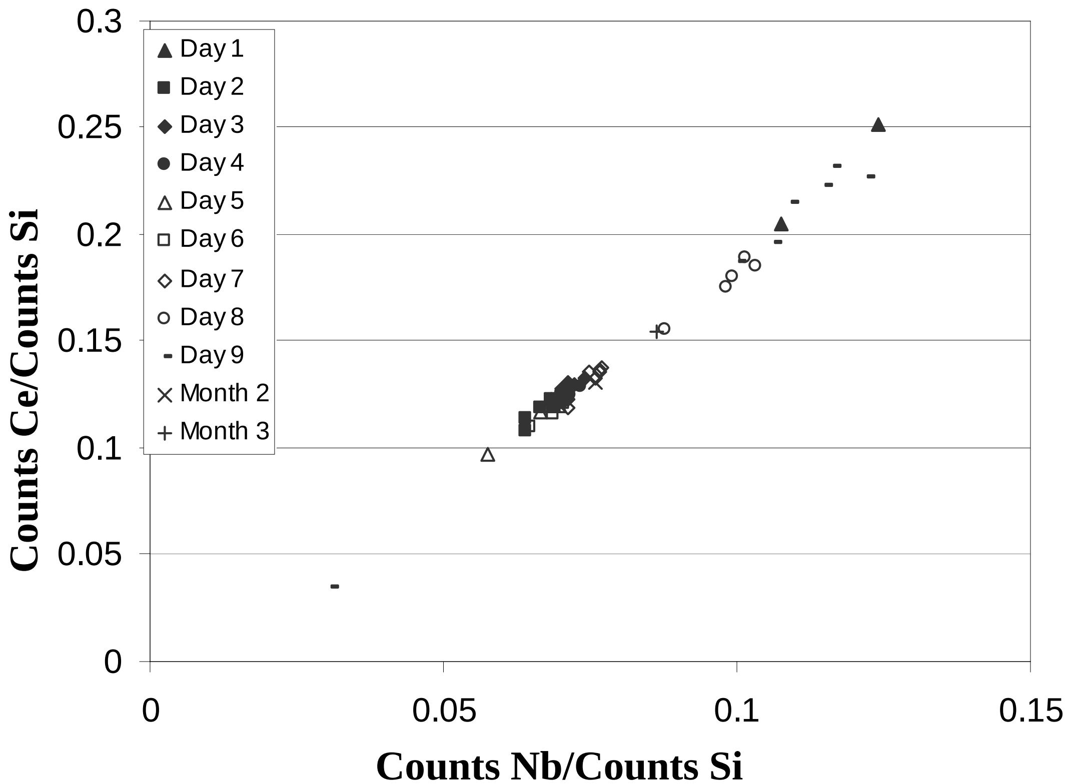

Figure 9: Bivariate plot of data from multiple Laser Ablation runs of standard GSD-1G. Shows linear trend consistent with normal machine drift. Demonstrates that machine drift over time is different for every element, and cannot be accounted for by internally standardizing to Si alone.

Table 6: Results of ICP-MS analysis of USGS GSD-1G Synthetic Basalt Glass Standard and previous analyses by others.

First two columns show results from this study. Third column shows average results from previous study (Jochum 2005). Fourth and fifth column show results provided by USGS (Wilson, 2004).

	GSD-1G pulv. (This Study)	GSD-1G powder (This Study)	Jochum (2005)	USGS Min	USGS max
Ba	65.4	64.0	68.9	40	70
Ce	38.0	35.1	41.7	25	40
Dy	39.6	38.8	51.0	40	55
Er	26.3	26.3	39.1	30	40
Eu	34.2	32.8	40.1	30	40
Fe	87970	86600	133000	55000	75000
Ga	56.5	56.2	53.2	50	70
Gd	41.4	39.3	49.3	40	60
Ho	35.3	35.3	49.2	30	60
Lu	30.5	31.0	52.3	40	60
Mn	209.0	208.1	240.0	150	250
Nb	46.1	44.1	43.8	30	50
Nd	39.5	36.5	44.5	20	50
Pr	38.8	36.1	46.0	30	50
Rb	18.4	19.5	37.7	30	50
Sm	41.1	38.5	46.9	30	60
Sr	59.8	61.5	69.4	50	70
Tb	38.6	37.0	47.5	30	60
Ti	8108	7872	13000	5000	10000
Tm	33.0	32.7	50.2	30	60
Y	20.3	21.3	44.0	30	60
Yb	31.9	32.0	51.2	40	60
Zn	110.9	110.0	-	30	80
Zr	75.8	68.2	47.1	30	60

** All data in PPM*

5. Discussion

All four previously identified subsources (Sugarloaf, West Sugarloaf, West Cactus Peak, and Joshua Ridge) are distinguishable using LA-ICP-MS with the use of bivariate plots. The Cactus Peak and East Sugarloaf grouping is the same as that observed by Hughes (1988). Additionally, the samples from the newly identified site we are calling the Stewart Quarry (after Richard Stewart) have been shown to be chemically identical to West Cactus Peak obsidian. The obsidian at the Stewart Quarry is present as float and is not yet associated with any outcrop or specific dome, so chemical grouping with West Cactus Peak will be helpful in determining the point of origin. Additionally, usage patterns of Coso obsidian have been discussed in terms of whether the various subsources could be seen or easily controlled from permanent settlements at Little Lake and Rose Spring to the west (Eerkins and Rosenthal, 2004). The identification of an available source of West Cactus Peak-identical obsidian several miles to the south of West Cactus Peak itself has implications for the interpretation of usage patterns. The grouping of East Sugarloaf obsidian with Cactus Peak has similar archaeological implications, since Cactus Peak is several miles to the north of Sugarloaf Mountain, and researchers should be cautious about interpreting a Coso subgroup identification as definitively locating the pinpoint origin of an artifact, since chemically identical obsidian can be found both in geologically separate domes, and in transported sediment over a wide area. By contrast, the potential variation within the West Sugarloaf subsource suggests that if the chemical variation of that very large and significant site could be mapped, artifacts could potentially be sourced to very exact locations.

It is worth noting that the LA-ICP-MS is less accurate than INAA and that precision likely varies between elements (James et al., 2005). Certain elements, like Fe, which were diagnostic in INAA analysis evaluation, are not suitable here because of the order of magnitude differences between major and trace elements. Fe is also somewhat problematic because of mass interferences for major isotopes, and in ICP-MS analysis of dissolved samples, interferences caused by use of nitric acid. This being said, further analysis of Sugarloaf Mountain is overdue. The amount of variation present in the large number of samples tested is greater than previously documented, which may be explained by the proximity of some of the collection sites to the border between the rhyolite domes. The SE Sugarloaf samples can potentially be distinguished from the rest of the West Sugarloaf Mountain sites (Figure 8). A study that analyzes samples from a greater number of locations on Sugarloaf Mountain may be extremely helpful in establishing the exact extent and significance of the variability. The outcrop samples used in the intra-flow section of the study do not show this same level of variation, suggesting that a larger scale of sampling is needed to detect the variation.

No effort was made to resolve differences in absolute (ppm) measurements between LA-ICP-MS analysis and solution ICP-MS, since the LA-ICP-MS data was internally consistent and reproducible. Further correction might yield better agreement.

The ease of distinction of the Eastern California sources in this study supports the use of this tool as a means of sourcing artifacts from the Western United States. The assembly of a more complete database of sources would be necessary first, but the simplicity of the method makes this a simple step.

Reproducibility of the LA-ICP-MS method is demonstrated with multiple runs of standard GSD-1G (Figure 9). Fifty-three runs were completed in Jan/Feb 2006, with 2 additional runs in March and April 2006. When internally standardized to silicon, this data demonstrates not only the reproducibility of the method over months, but the real need for a standard containing all of the elements being tested. Machine drift over time is different for every element, which means that the element ratios derived from an internally based standardization vary. If test samples were converted to ppm using a single conversion factor or an internal standard derived from one or two elements, then an artificial separation would be seen (Figure 10).

The USGS Synthetic Basalt Glass Standard GSD-1G was also analyzed through total dissolution and introduction into the ICP-MS. Results from this analysis demonstrated consistency between the powdered and solid forms of the standard and general agreement with USGS analysis and other published data on GSD-1G (Table 6) (Jochum et al., 2005). Most elements fell within or very near levels previously reported. Notable exceptions were Rb and Zr, the two elements used by Hughes (1988) to separate the Coso subsources. If these elements vary or are in any way inconsistent in the standard, the interpretation of the variation found in these elements would be significantly impacted. The GSD-1G standard has been found to be very useful and consistent in this study. Several minor issues exist, however. Pieces of the standard are generally very small and have an uneven, cracked

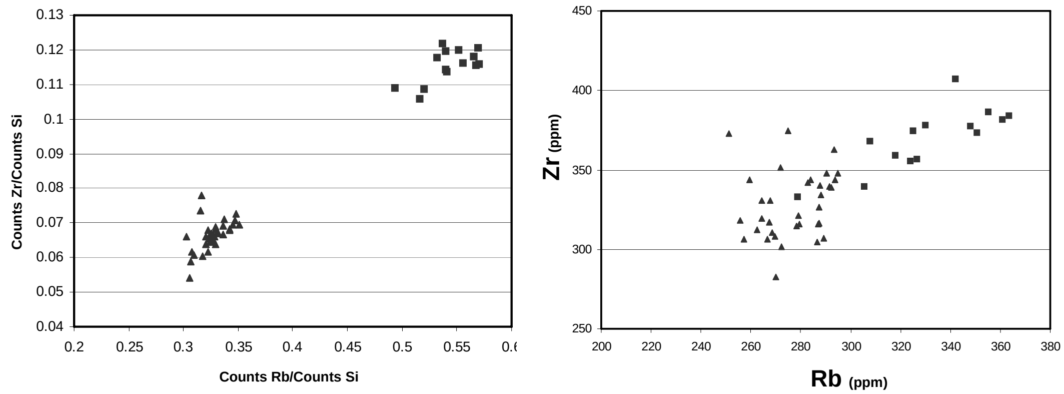

Figure 10: Bivariate Rb/Zr plots demonstrating potential for misinterpretation if data is not corrected for machine drift on an element-by-element basis.

Both graphs show groups from the same subsource that were tested on different days.

The graph on the left shows counts/Si. This method assumes a constant amount of Si and a constant amount of machine drift for every element. Groups appear distinct.

The graph on the right shows ppm. This method assumes a constant amount of Si, but uses a scaled correction factor for each element. Groups are not distinguishable anymore.

surface. This study utilized more than 50 ablations of the standard, filling up almost all the available surface. Solutions to this problem include breaking to create new smooth surface area (impractical due to the already small size), polishing the surface (time consuming and tedious), making compacted pellets from the powdered form of the standard, or mounting the standard in epoxy and grinding or cutting off the analyzed portions. None of the last three methods have been tested yet. The standard was broken once during testing to provide a fresh surface, but was too small to break a second time and still preserve sufficient surface area.

6. Conclusions

Laser Ablation ICP-MS is a viable technique for obsidian provenance studies in the Western US. Eastern California sources are readily identifiable by this method and a database for comparison for the purpose of identifying archaeological material has been established. Additionally, all Coso subsources are distinguishable, and are comparable with the results of previous studies, which supports the adoption of LA-ICP-MS as an alternative to XRF and INAA. The newly identified Stewart Quarry has been shown to be in the West Cactus Peak chemical subgroup, which has significant implications for archaeological interpretation of subsource use in terms of geography. The Laser Ablation ICP-MS technique is extremely rapid (analysis and processing of +40 samples per day), minimally destructive to both the obsidian and to any potential residue on the surface, requires little/no sample preparation, and has now been shown to be both accurate and reproducible.

USGS GSD-1G has proven extremely consistent and useful for this study, and adoption of this type of standard should be instrumental in overcoming the issues previously encountered in the use of LA-ICP-MS.

7. Further Studies

Further analysis is planned using a Scanning Electron Microscope to determine major element levels in Coso obsidian. Additionally, an isotope study is planned, using the available digested samples.

A detailed geochemical study of West Sugarloaf Mountain could reveal small intra-flow variations, as suggested by the results of ICP-MS after microwave digestion analysis. This possible variation was not detectable by LA-ICP-MS, so a more accurate and precise method, such as INAA, maybe more suitable for that type of study.

Since pieces of the solid form of the GSD-1G standard are fairly small, multiple ablations runs cover the available surface fairly quickly, necessitating grinding it down or otherwise smoothing it. An alternative would be to create a flat pellet from the powder form of the standard. The resulting surface would be different enough to need further analysis before adoption, but is a promising, reliable, less labor-intensive alternative.

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Appendix A: 2002 CSUB Study

The 2002 CSUB project included the analysis and comparison of ~40 pieces of Coso obsidian. Conversion of the raw data into ppm was attempted using NIST standard #612, but this calculation was unsuccessful for several reasons. Firstly, NIST 612 does not include all the elements being studied. Secondly, one of the key issues in LA-ICP-MS is that different amounts of samples are ablated in each run, and NIST 612 ablates much differently from obsidian, as it is a semi-transparent light blue in color. Addressing calibration and conversion issues is one of the primary foci of this current study. This study used a newly available synthetic basalt glass standard, made available to us by the USGS. In addition to being visually and texturally similar to the obsidian, it contains all of the elements being studied. In order to further address calibration and quantification issues, a selected number of samples were dissolved and introduced as liquid samples in the ICP-MS.

Another issue raised by the pilot project was the need for a sufficiently large number of samples to enable valid advanced statistics if necessary. The original sample set was expanded to include every suitable sample collected in the field (223 collected in 2002) plus an additional 24 samples collected in 2004. The expanded set includes 247 samples of Coso obsidian. This set includes samples collected from a non-tool quality outcrop in order to study intra-flow variability. Another goal of the current project is to establish a database of eastern California sources. Dr. Yohe (CSUB) provided a set of seven separate Eastern California obsidians for this purpose.

Appendix B: Conversion of Laser Ablation Data from Counts to PPM

Measurements from the ICP-MS are reported as counts. Every element from every sample was converted into PPM using a linear scaled conversion.

First, a correction factor relative to Si was calculated for each element in every run of the standard.

Per Element Correction Factor = X = (Element Counts/(Si Counts/Concentration Si))/Concentration Element OR

$$\frac{\text{Element Counts}}{\text{Si Counts}} * \frac{\text{Concentration Si}}{\text{Concentration Element}}$$

These correction factors were applied to the obsidian sample counts using the standards before and after a set of samples. The example uses a sample set of One Standard-Five Obsidian-One Standard. Drift between the 2 standards was assumed to be regular and constant. Actual amount of Si was assumed to be 77%.

X_1=Correction factor from First Standard

X_2= correction factor from second standard

N= 1,2,3,4,5, for 1st sample, second sample, etc, N_t=Number of samples in set

$$\text{PPM} = \frac{\frac{\text{Counts}}{\text{CountsSi}} * 77000}{(X_1-((X_1-X_2)/(N_t+1))*N)}$$

This method accounts for different drift of elements by including a per-element correction factor, different amounts of sample ablation by tying conversion to Si, and drift over time by scaling correction between 2 standards.

Example on following page:

Appendix B cont.: Conversion of Laser Ablation Data from Counts to PPM (Example)

Standard 1:	
Concentration Si:	250000 ppm
Concentration Mn:	209 ppm
Mn Counts:	462996
Si Counts:	1688491
X_1:	**328**

Standard 2:	
Concentration Si:	250000 ppm
Concentration Mn:	209 ppm
Mn Counts:	351154
Si Counts:	1202730
X2:	**349**

$$X1 = \frac{462996}{(1688491/250000)} \;/\; 209 = 328$$

$$X2 = \frac{351154}{(1202730/250000)} \;/\; 209 = 349$$

Sample 2 of 5:	
Counts Mn:	1177597
Counts Si:	4839271

$$PPM = \frac{\frac{1177597}{4839271} * 77000}{(328-((328-349)/(6))*2)}$$ **= 559.3 ppm Mn**

Appendix C : Mass of samples used in Microwave Digestion.

Sample	Mass (g)
WestSugar4-M	0.0998
WestSugar1-O	0.0990
WestSugar2-R	0.0995
WestSugar3-I	0.1000
JoshuaRidge-R	0.1002
JoshuaRidge-T	0.1000
JoshuaRidgeB-J	0.0997
JoshuaRidgeB-L	0.1001
JoshuaRidge-O	0.0997
SouthSugar1-L	0.0999
SouthSugar2-L	0.1000
SouthSugar3a-N	0.0995
SouthSugar3b-I	0.1004
SESugar1-O	0.1004
SESugar1-V	0.0996
SESugar2-L	0.1002
SESugar2-F	0.0998
SouthStewart-M	0.0998
NorthStewart-J	0.1003
SouthStewart-K	0.0996
SouthStewart-L	0.0996
Cactus1-J	0.0999
Cactus1-L	0.1003
Cactus2-T	0.0997
BodieHills	0.0997
Mt Hicks	0.0995
Shoshone	0.0997
GSD-1G pulv.	0.0997
GSD-1G powder	0.1004
Acid Blank	0.0000

Appendix D: EPA Method 3052 See EPA website for full text and description of method.

Exact description of CSUB lab methods included here.

CD-ROM 3052 - 1 Revision 0
December 1996
METHOD 3052
MICROWAVE ASSISTED ACID DIGESTION OF SILICEOUS AND
ORGANICALLY BASED MATRICES
1.0 SCOPE AND APPLICATION
1.1 This method is applicable to the microwave assisted acid digestion of siliceous matrices, and organic matrices and other complex matrices. If a total decomposition analysis (relative to the target analyte list) is required, the following matrices can be digested: ashes, biological tissues, oils, oil contaminated soils, sediments, sludges, and soils. This method is applicable for the following elements:
Aluminum Cadmium Iron Molybdenum Sodium Antimony Calcium Lead Nickel Strontium Arsenic Chromium Magnesium Potassium Thallium Boron Cobalt Manganese Selenium Vanadium Barium Copper Mercury Silver Zinc Beryllium
Other elements and matrices may be analyzed by this method if performance is demonstrated for the analyte of interest, in the matrices of interest, at the concentration levels of interest (see Sec. 8.0).
Note: This technique is not appropriate for regulatory applications that require the use of leachate preparations (i.e., Method 3050, Method 3051, Method 1311, Method 1312, Method 1310, Method 1320, Method 1330, Method 3031, Method 3040). This method is appropriate for those applications requiring a total decomposition for research purposes (i.e., geological studies, mass balances, analysis of Standard Reference Materials) or in response to a regulation that requires total sample decomposition.
1.2 This method is provided as a rapid multi-element, microwave assisted acid digestion prior to analysis protocol so that decisions can be made about the site or material. Digests and alternative procedures produced by the method are suitable for analysis by flame atomic absorption spectrometry (FLAA), cold vapor atomic absorption spectrometry (CVAA), graphite furnace atomic absorption spectrometry (GFAA), inductively coupled plasma atomic emission spectrometry (ICPAES), inductively coupled plasma mass spectrometry (ICP-MS) and other analytical elemental analysis techniques where applicable. Due to the rapid advances in microwave technology, consult your manufacturer's recommended instructions for guidance on their microwave digestion system and refer to this manual’s "Disclaimer" when conducting analyses using Method 3052.
1.3 The goal of this method is total sample decomposition and with judicious choice of acid combinations this is achievable for most matrices (see Sec. 3.2). Selection of reagents which give the highest recoveries for the target analytes is considered the optimum method condition.

2.0 SUMMARY OF METHOD
2.1 A representative sample of up to 0.5 g is digested in 9 mL of concentrated nitric acid and usually 3 mL hydrofluoric acid for 15 minutes using microwave heating with a suitable laboratory microwave system. The method has several additional alternative acid and reagent combinations including hydrochloric acid and hydrogen peroxide. The method has provisions for scaling up the sample size to a maximum of 1.0 g. The sample and acid are placed in suitably inert polymeric microwave vessels. The vessel is sealed and heated in the microwave system. The temperature profile is specified to permit specific reactions and incorporates reaching 180 ± 5 ºC in approximately less than 5.5 minutes and remaining at 180 ± 5 ºC for 9.5 minutes for the completion of specific reactions (Ref. 1, 2, 3, 4). After cooling, the vessel contents may be filtered, centrifuged, or allowed to settle and then decanted, diluted to volume, and analyzed by the appropriate SW-846 method.
3.0 INTERFERENCES
3.1 Gaseous digestion reaction products, very reactive, or volatile materials that may create high pressures when heated and may cause venting of the vessels with potential loss of sample and analytes. The complete decomposition of either carbonates, or carbon based samples, may cause enough pressure to vent the vessel if the sample size is greater than 0.25 g. Variations of the method due to very reactive materials are specifically addressed in sections 7.3.4 and 7.3.6.1.
3.2 Most samples will be totally dissolved by this method with judicious choice of the acid combinations. A few refractory sample matrix compounds, such as TiO_2, alumina, and other oxides may not be totally dissolved and in some cases may sequester target analyte elements.
3.3 The use of several digestion reagents that are necessary to either completely decompose the matrix or to stabilize specific elements may limit the use of specific analytical instrumentation methods. Hydrochloric acid is known to interfere with some instrumental analysis methods such as flame atomic absorption (FLAA) and inductively coupled plasma atomic emission spectrometry (ICP-AES). The presence of hydrochloric acid may be problematic for graphite furnace atomic absorption (GFAA) and inductively coupled plasma mass spectrometry (ICP-MS).
Hydrofluoric acid, which is capable of dissolving silicates, may require the removal of excess hydrofluoric acid or the use of specialized non-glass components during instrumental analysis.
Method 3052 enables the analyst to select other decomposition reagents that may also cause problems with instrumental analyses necessitating matrix matching of standards to account for viscosity and chemical differences.
4.0 APPARATUS AND MATERIALS
4.1 Microwave apparatus requirements.
4.1.1 The temperature performance requirements necessitate the microwave decomposition system sense the temperature to within ± 2.5EC and automatically adjust the microwave field output power within 2 seconds of sensing. Temperature sensors should be accurate to ± 2EC (including the final reaction temperature of 180EC). Temperature feedback control provides the primary control performance mechanism for the method. Due to the flexibility in the reagents used to achieve total analysis, tempertuare feedback control is necessary for reproducible microwave heating.

Alternatively, for a specific set of reagent(s) combination(s), quantity, and specific vessel type, a calibration control mechanism can be developed similar to previous microwave methods (see Method 3051). Through calibration of the microwave power, vessel load and heat loss, the reaction temperature profile described in Section 7.3.6 can be reproduced. The calibration settings are specific for the number and type of vessel used and for the microwave system in addition to the variation in reagent combinations. Therefore no specific calibration settings are provided in this method. These settings may be developed by using temperature monitoring equipment for each specific set of equipment and reagent combination. They may only be used if not altered as previously described in other methods such as 3051 and 3015. In this circumstance, the microwave system provides programmable power which can be programmed to within ± 12 W of the required power. Typical systems provide a nominal 600 W to 1200 W of power (Ref. 1, 2, 5). Calibration control provides backward compatibility with older laboratory microwave systems without temperature monitoring or feedback control and with lower cost microwave systems for some repetitive analyses. Older lower pressure vessels may not be compatible.

4.1.2 The temperature measurement system should be periodically calibrated at an elevated temperature. Pour silicon oil (a high temperature oil into a beaker and adequately stirred to ensure a homogeneous temperature. Place the microwave temperature sensor and a calibrated external temperature measurement sensor into the beaker. Heat the beaker to a constant temperature of 180 ± 5°C. Measure the temperature with both sensors. If the measured temperatures vary by more than 1 - 2°C, the microwave temperature measurement system needs to be calibrated. Consult the microwave manufacturer's instructions about the specific temperature sensor calibration procedure.

CAUTION: The use of microwave equipment with temperature feedback control is required to control the unfamiliar reactions of unique or untested reagent combinations of unknown samples. These tests may require additional vessel requirements such as increased pressure capabilities.

4.1.3 The microwave unit cavity is corrosion resistant and well ventilated. All electronics are protected against corrosion for safe operation.

CAUTION: There are many safety and operational recommendations specific to the model and manufacturer of the microwave equipment used in individual laboratories. A listing of these specific suggestions is beyond the scope of this method and require the analyst to consult the specific equipment manual, manufacturer, and literature for proper and safe operation of the microwave equipment and vessels.

4.1.4 The method requires essentially microwave transparent and reagent resistant suitably inert polymeric materials (examples are PFA or TFM suitably inert polymeric polymers) to contain acids and samples. For higher pressure capabilities the vessel may be contained within layers of different microwave transparent materials for strength, durability, and safety. The vessels internal volume should be at least 45 mL, capable of withstanding pressures of at least 30 atm (30 bar or 435 psi), and capable of controlled pressure relief. These specifications are to provide an appropriate, safe, and durable reaction vessel of which there are many adequate designs by many suppliers.

To Use Perkin-Elmer, Anton Paar Multiwave Microwave
(Procedure may vary according to Method used)

1.) Weigh out samples (~0.1 g) into Teflon vessels, recording which sample is going into which vessel and the weight of the sample (If there is any lag time, longer than an hour or so, the samples in the vessels may need to be covered with a bit of saran wrap to try to keep out excess dust).
2.) Turn on microwave and select method (e.g. EPA Method 3052).
3.) Suit up completely with small gloves, goggles, lab coat, apron, face shield, and large, black neoprene gloves.
4.) Put already numbered rack with Teflon vessels, containing previously weighed samples in the chemical fume hood.
5.) **CAREFULLY**, get HF acid (including secondary containment bucket) out of storage cabinet and put into the chemical fume hood (it is usually easier to have one person hold the cabinet’s door and the other pull out the acid, but **BOTH** individuals must be fully suited up).
6.) Turn spout of dispenser out of the bucket, being careful not to put any weight on the spout (dispenser is gravity driven; weight will cause more acid to spill out than you will need).
7.) Uncap spout and dispense one full aliquot of acid out into the waste bottle (the plastic, PVC, one). Continue to dispense acid until no bubbles are dispensed with the acid. This will insure consistent amounts of acid dispensed.
8.) When no bubbles are dispensed with the acid, carefully put one aliquot (for EPA Method 3052, this would be when the dispenser is set at 3 mL) into each Teflon vessel, carefully returning each vessel to its numbered slot in the rack. It is easier to bring the vessel up to the tip of the spout than to try out target skills with the HF.
9.) Once all six vessels have HF added, cap the spout and turn the tip of the spout back into the bucket. Have your lab partner open the storage cabinet and carefully put the HF away.
10.) Remove the large, cumbersome black gloves.
11.) Get the Nitric acid (including secondary containment bucket) out from the chemical cabinet.
12.) Set bucket with Nitric acid in the fume hood.
13.) Turn spout over side of bucket.
14.) Uncap (again, no weight should be put on the spout of the dispenser nor should the dispenser be left in the “up position” or an awful mess will occur) and prime the dispenser as done with the HF, only in the Nitric Acid’s glass waste jar (**DON’T** mix the wastes of the acids!).
15.) When no bubbles come out with the acid, carefully dispense 6 aliquots (e.g. with the EPA 3052 method, the dispenser is set at 1.5 mL) of acid into each of the Teflon vessels (try not to splash when dispensing).
16.) Cap the spout on the acid dispenser, turn spout into the bucket and (with partner’s help) return acid to chemical storage cabinet.
17.) Gently, cap the vessels (Carefully examine entire cap for damage or contamination. Gently put the cap on the clean seal-forming tool and using the first 3 fingers of your hand, rub the cap on the tool. Let the cap take its own lead. It’ll feel kind of like a toggling motion, but all parts of the lip on the cap should get equal exposure to the tool. You will know if you have done this correctly and entirely, when the cap is put on the vessel and it pops up a bit. This shows a good seal.)
18.) Place vessels into bombs one at a time and place bomb directly into the corresponding numbered place on the carousel. This will prevent mix-up of samples, if done one at a time.
19.) Make sure that each bomb is set in its place so that it doesn’t wiggle.

20.) When all 6 bombs are in place, put the blast shield over the carousel, covering the vessels.

21.) Push the tabs on the top of the vessel over the blast shield and tighten every other screw on the top of the tabs firmly BY HAND, no tools (this will help to insure even tightening of the blast shield. Also, if the screws are tightened by hand, then they can be removed with help from the tool if necessary. If the tool is used to tighten the screws, the samples will not be able to be removed from the carousel and are, thus, useless). Then screw down the remaining screws, firmly as well, making sure all are hand-tight.

22.) Put carousel into the microwave in its slot. Double check and make sure it doesn't wobble.

23.) Enter method on keypad.

24.) Wait for start/ stop prompt on the screen of the microwave and push "start."

25.) Then wait for the microwave to digest your sample and run through its program. Microwave will prompt you when program and cool down are complete.

After digestion:

1.) Remove carousel from microwave and put in the fume hood.

2.) Unscrew the screws on the top of the carousel (you may need to use the tool), making sure that the black tabs that hold on the blast shield are no longer in place.

3.) Remove blast shield from carousel. Return blast shield to original place it was found outside the fume hood.

4.) Carefully remove each bomb from the carousel, leaving them in numerical order (1-6).

5.) Once all bombs have been removed, return the carousel to the place it was originally found outside the fume hood.

6.) One by one, partially unscrew the top of each bomb (They may make a venting noise and will release a poisonous gas, often reddish-brown.) and let each vent a bit. Continue to partially unscrew the tops until no gas is heard or seen.

7.) The Teflon vessels can be removed from the bomb and ceramic sleeves and put back in the rack.

8.) Carefully pull the caps off of each vessel one by one (may release more poisonous gas). As each cap is pulled off of the vessel, carefully rinse the top with nanopure water three times into the Teflon tubes, so as not to loose any sample that may be clinging to the cap of the vessel.

9.) Next, rinse each vessel three times with nanopure water into the 50 mL containers provided, and top off the 50 mL container to the 50 mL line with nanopure water. Samples are ready to be diluted and used.

This procedure was developed using EPA Method 3052, Microwave Assisted Acid Digestion Of Siliceous And Organically Based Matrices, SW-846.

Appendix E: Conversion of ICP-MS from microwave digestion data from Counts to PPM. (Golob, 2005)

(in progress)

Measurements from the ICP-MS are reported as µg/L.of solution. Every measurement of each element from every sample was corrected using a linear scaled conversion from standards.

A correction factor was obtained by dividing 10^{-6} g/L (equivalent to 1 ppb) by ~ 0.2 g/L (from the dilution factor (approximately 0.10 g per 500 mL of solution) and varying depending on mass of sample dissolved).
This gives a conversion factor of CF = 10^{-6} /0.2 = 5.0×10^{-6}

This conversion factor was calculated for each sample and used to covert sample measurements into ppm as follows:
Ppm = counts per element x 10^{6} x (CF)
(second term of equation accounts for µg/L to g/L conversion)

Example:

Sample Mass : 0.0998 g

CF = 5.010×10^{-6}

Mn reported measurement = 49.949

Ppm Mn = (49.949 x 10^{6} x 5.010×10^{-6}) = 250.25 ppm

Appendix F: Output of Statistical Analysis using SPSS software of Laser Ablation data from Coso Obsidian, with collection site used as grouping number.

Discriminant

[DataSet1]

Analysis Case Processing Summary

Unweighted Cases		N	Percent
Valid		243	86.2
Excluded	Missing or out-of-range group codes	34	12.1
	At least one missing discriminating variable	0	.0
	Both missing or out-of-range group codes and at least one missing discriminating variable	5	1.8
	Total	39	13.8
Total		282	100.0

Group Statistics

V2		Mean	Std. Deviation	Valid N (listwise) Unweighted	Valid N (listwise) Weighted
1	Ti47	607.18155	26.645797	33	33.000
	Mn55	570.55851	27.619381	33	33.000
	Zn66	268.93496	29.242188	33	33.000
	Ga69	55.96658	3.195087	33	33.000
	Rb85	271.11269	16.421801	33	33.000
	Sr88	4.47236	.859052	33	33.000
	Y89	31.74227	2.490334	33	33.000
	Zr90	274.28479	21.582745	33	33.000
	Nb93	104.28888	3.852024	33	33.000
	Ba137	17.53022	11.404532	33	33.000
	Fe57	10297.307	495.677121	33	33.000
	Ce140	67.57628	4.075330	33	33.000
	Nd146	24.76879	1.883814	33	33.000
	Sm147	6.73961	.486038	33	33.000
	Eu153	.08093	.006453	33	33.000
	Tb159	1.21893	.100249	33	33.000
	Dy163	7.82764	.639021	33	33.000
	Er166	4.55601	.373440	33	33.000
	Tm169	.70380	.059282	33	33.000
	Yb172	4.77325	.382478	33	33.000
	Pr141	6.61446	.477893	33	33.000
	Ho165	1.56327	.130447	33	33.000
	Lu175	.62518	.051557	33	33.000
	Gd158	6.75928	.556553	33	33.000
2	Ti47	987.53880	61.822297	9	9.000
	Mn55	510.30146	30.276046	9	9.000
	Zn66	270.88653	30.217306	9	9.000
	Ga69	52.08943	3.206288	9	9.000
	Rb85	212.44388	10.282977	9	9.000
	Sr88	11.16808	.917501	9	9.000
	Y89	28.85912	3.307380	9	9.000
	Zr90	395.86468	39.804730	9	9.000
	Nb93	87.16729	4.839233	9	9.000
	Ba137	68.43076	5.426908	9	9.000
	Fe57	12667.473	685.234190	9	9.000
	Ce140	136.17028	10.315821	9	9.000
	Nd146	39.94449	4.201437	9	9.000
	Sm147	8.25227	.906957	9	9.000
	Eu153	.18840	.021209	9	9.000
	Tb159	1.20767	.130798	9	9.000
	Dy163	7.59418	.837076	9	9.000
	Er166	4.17398	.475617	9	9.000
	Tm169	.63853	.069625	9	9.000
	Yb172	4.27803	.449156	9	9.000
	Pr141	11.76636	1.160435	9	9.000
	Ho165	1.47701	.174536	9	9.000
	Lu175	.56301	.064883	9	9.000
	Gd158	7.30653	.789510	9	9.000
3	Ti47	567.53031	27.477149	17	17.000
	Mn55	543.69740	23.372873	17	17.000
	Zn66	399.72516	44.905546	17	17.000
	Ga69	74.07121	7.045442	17	17.000
	Rb85	402.48410	44.872591	17	17.000
	Sr88	2.18322	.265890	17	17.000
	Y89	50.15488	4.114024	17	17.000
	Zr90	361.32891	74.365247	17	17.000
	Nb93	165.95468	11.858883	17	17.000
	Ba137	3.76493	.294085	17	17.000
	Fe57	11425.036	541.031589	17	17.000
	Ce140	75.47560	4.947015	17	17.000
	Nd146	32.51742	2.588798	17	17.000
	Sm147	10.45816	.769281	17	17.000
	Eu153	.02715	.002488	17	17.000
	Tb159	2.04249	.173335	17	17.000
	Dy163	13.19518	1.133902	17	17.000
	Er166	7.33110	.645780	17	17.000
	Tm169	1.10441	.093619	17	17.000
	Yb172	7.38484	.669014	17	17.000
	Pr141	8.09560	.685720	17	17.000
	Ho165	2.56739	.229656	17	17.000
	Lu175	.98657	.083737	17	17.000
	Gd158	11.15873	.813294	17	17.000

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Group Statistics

V2		Mean	Std. Deviation	Valid N (listwise)	
				Unweighted	Weighted
4	Ti47	752.87193	29.495967	48	48.000
	Mn55	527.32988	23.159317	48	48.000
	Zn66	300.56636	33.932607	48	48.000
	Ga69	58.18557	4.188812	48	48.000
	Rb85	292.78211	29.841366	48	48.000
	Sr88	8.59034	.712629	48	48.000
	Y89	33.51992	2.899096	48	48.000
	Zr90	340.19101	28.025903	48	48.000
	Nb93	107.01245	3.896159	48	48.000
	Ba137	46.86539	3.489304	48	48.000
	Fe57	11534.629	563.849225	48	48.000
	Ce140	103.45482	5.318157	48	48.000
	Nd146	32.45896	2.724087	48	48.000
	Sm147	7.72645	.661862	48	48.000
	Eu153	.11773	.009687	48	48.000
	Tb159	1.30732	.119130	48	48.000
	Dy163	8.46965	.763221	48	48.000
	Er166	4.83864	.428041	48	48.000
	Tm169	.75045	.071310	48	48.000
	Yb172	5.11669	.459879	48	48.000
	Pr141	9.20913	.646728	48	48.000
	Ho165	1.66646	.161356	48	48.000
	Lu175	.66975	.065426	48	48.000
	Gd158	7.37831	.640087	48	48.000
5	Ti47	785.68506	55.632613	55	55.000
	Mn55	511.88336	18.705692	55	55.000
	Zn66	274.94764	29.546758	55	55.000
	Ga69	56.44893	3.639331	55	55.000
	Rb85	287.96204	27.488997	55	55.000
	Sr88	9.63510	1.684697	55	55.000
	Y89	31.78327	2.949411	55	55.000
	Zr90	349.71607	30.216227	55	55.000
	Nb93	102.92097	6.160134	55	55.000
	Ba137	57.42570	13.029661	55	55.000
	Fe57	11106.107	550.906624	55	55.000
	Ce140	106.23747	7.117749	55	55.000
	Nd146	32.29411	2.671621	55	55.000
	Sm147	7.49799	.608562	55	55.000
	Eu153	.12817	.018160	55	55.000
	Tb159	1.29629	.116972	55	55.000
	Dy163	8.10391	.759683	55	55.000
	Er166	4.62748	.448124	55	55.000
	Tm169	.71522	.071588	55	55.000
	Yb172	4.87127	.479416	55	55.000
	Pr141	9.30655	.703565	55	55.000
	Ho165	1.58649	.155298	55	55.000
	Lu175	.63623	.065019	55	55.000
	Gd158	7.15799	.611802	55	55.000

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Group Statistics

V2		Mean	Std. Deviation	Valid N (listwise)	
				Unweighted	Weighted
6	Ti47	763.14421	46.240434	61	61.000
	Mn55	531.25598	38.030773	61	61.000
	Zn66	276.03461	23.626407	61	61.000
	Ga69	57.15600	3.820406	61	61.000
	Rb85	284.84184	24.751825	61	61.000
	Sr88	8.63657	1.174985	61	61.000
	Y89	32.30821	2.107485	61	61.000
	Zr90	334.00061	20.098872	61	61.000
	Nb93	105.80847	3.993534	61	61.000
	Ba137	47.94654	7.114588	61	61.000
	Fe57	11392.785	424.894013	61	61.000
	Ce140	103.13014	5.537436	61	61.000
	Nd146	31.48811	2.072546	61	61.000
	Sm147	7.48069	.494361	61	61.000
	Eu153	.11778	.011129	61	61.000
	Tb159	1.26658	.083502	61	61.000
	Dy163	8.20684	.547220	61	61.000
	Er166	4.68825	.312693	61	61.000
	Tm169	.72589	.049795	61	61.000
	Yb172	4.95102	.358823	61	61.000
	Pr141	9.00676	.580847	61	61.000
	Ho165	1.60944	.118105	61	61.000
	Lu175	.64585	.046913	61	61.000
	Gd158	7.12493	.438869	61	61.000
7	Ti47	609.10468	64.804347	10	10.000
	Mn55	581.39677	88.535168	10	10.000
	Zn66	465.27394	97.492401	10	10.000
	Ga69	89.63162	13.352274	10	10.000
	Rb85	439.93978	49.902947	10	10.000
	Sr88	2.44036	.304962	10	10.000
	Y89	52.79853	7.865188	10	10.000
	Zr90	360.12998	48.570394	10	10.000
	Nb93	173.91659	20.202905	10	10.000
	Ba137	5.20981	.584427	10	10.000
	Fe57	13964.741	2147.147984	10	10.000
	Ce140	75.96768	7.236309	10	10.000
	Nd146	33.14424	4.736239	10	10.000
	Sm147	10.87336	1.542271	10	10.000
	Eu153	.03239	.007809	10	10.000
	Tb159	2.14980	.316038	10	10.000
	Dy163	13.80239	1.950884	10	10.000
	Er166	7.68184	1.036512	10	10.000
	Tm169	1.15145	.161252	10	10.000
	Yb172	7.62578	1.058854	10	10.000
	Pr141	8.30141	1.059085	10	10.000
	Ho165	2.68608	.378724	10	10.000
	Lu175	1.01112	.141062	10	10.000
	Gd158	11.83760	1.739838	10	10.000

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Group Statistics

V2		Mean	Std. Deviation	Valid N (listwise) Unweighted	Valid N (listwise) Weighted
8	Ti47	621.21821	64.487227	10	10.000
	Mn55	543.24884	36.922712	10	10.000
	Zn66	290.30115	29.453212	10	10.000
	Ga69	60.66648	4.375673	10	10.000
	Rb85	272.10651	22.660663	10	10.000
	Sr88	6.44845	.825629	10	10.000
	Y89	32.98667	3.723345	10	10.000
	Zr90	299.03205	37.224498	10	10.000
	Nb93	98.69834	8.923586	10	10.000
	Ba137	26.12902	3.805886	10	10.000
	Fe57	10540.410	789.450234	10	10.000
	Ce140	73.58082	7.023189	10	10.000
	Nd146	26.59635	2.997909	10	10.000
	Sm147	6.92045	.726258	10	10.000
	Eu153	.10594	.013641	10	10.000
	Tb159	1.25207	.126280	10	10.000
	Dy163	8.15384	.841916	10	10.000
	Er166	4.84779	.665153	10	10.000
	Tm169	.75202	.118409	10	10.000
	Yb172	5.16108	.920765	10	10.000
	Pr141	7.10998	.746947	10	10.000
	Ho165	1.63564	.194599	10	10.000
	Lu175	.69622	.153649	10	10.000
	Gd158	6.95121	.687839	10	10.000
Total	Ti47	726.74243	100.725351	243	243.000
	Mn55	534.08432	36.898675	243	243.000
	Zn66	296.50752	59.069605	243	243.000
	Ga69	59.51308	9.078452	243	243.000
	Rb85	296.65338	63.343788	243	243.000
	Sr88	7.57729	2.765379	243	243.000
	Y89	34.33930	6.799766	243	243.000
	Zr90	334.51007	43.572522	243	243.000
	Nb93	111.21383	21.898393	243	243.000
	Ba137	40.75908	20.354672	243	243.000
	Fe57	11338.697	988.698847	243	243.000
	Ce140	96.02449	17.896807	243	243.000
	Nd146	31.20185	4.124111	243	243.000
	Sm147	7.78595	1.249330	243	243.000
	Eu153	.10739	.036378	243	243.000
	Tb159	1.35368	.288938	243	243.000
	Dy163	8.75192	1.852169	243	243.000
	Er166	4.98185	1.003767	243	243.000
	Tm169	.76708	.147719	243	243.000
	Yb172	5.20561	.964176	243	243.000
	Pr141	8.72109	1.296886	243	243.000
	Ho165	1.71687	.360804	243	243.000
	Lu175	.68206	.129875	243	243.000
	Gd158	7.60848	1.518634	243	243.000

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Tests of Equality of Group Means

	Wilks' Lambda	F	df1	df2	Sig.
Ti47	.194	139.479	7	235	.000
Mn55	.686	15.392	7	235	.000
Zn66	.349	62.497	7	235	.000
Ga69	.271	90.473	7	235	.000
Rb85	.273	89.303	7	235	.000
Sr88	.161	174.623	7	235	.000
Y89	.212	124.963	7	235	.000
Zr90	.566	25.703	7	235	.000
Nb93	.095	319.778	7	235	.000
Ba137	.173	160.962	7	235	.000
Fe57	.446	41.658	7	235	.000
Ce140	.111	269.203	7	235	.000
Nd146	.398	50.854	7	235	.000
Sm147	.278	87.179	7	235	.000
Eu153	.115	257.761	7	235	.000
Tb159	.189	144.107	7	235	.000
Dy163	.188	144.645	7	235	.000
Er166	.213	124.093	7	235	.000
Tm169	.249	101.120	7	235	.000
Yb172	.272	89.729	7	235	.000
Pr141	.264	93.675	7	235	.000
Ho165	.210	126.018	7	235	.000
Lu175	.290	82.170	7	235	.000
Gd158	.194	139.880	7	235	.000

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Pooled Within-Groups Matrices[a]

		Ti47	Mn55	Zn66	Ga69	Rb85	Sr88	Y89
Covariance	Ti47	2026.851	896.405	-276.969	29.907	198.265	38.195	64.867
	Mn55	896.405	961.325	203.325	62.986	146.224	16.094	47.418
	Zn66	-276.969	203.325	1255.465	125.386	545.602	3.692	20.067
	Ga69	29.907	62.986	125.386	22.960	111.295	.849	8.146
	Rb85	198.265	146.224	545.602	111.295	800.615	3.738	50.892
	Sr88	38.195	16.094	3.692	.849	3.738	1.270	1.193
	Y89	64.867	47.418	20.067	8.146	50.892	1.193	10.080
	Zr90	812.220	389.921	112.791	52.740	364.548	19.872	80.059
	Nb93	160.017	105.007	.166	16.505	118.129	1.061	17.252
	Ba137	244.572	91.345	11.042	1.932	-2.362	9.073	5.010
	Fe57	16234.843	17339.843	5199.413	1611.689	3277.287	237.687	936.187
	Ce140	212.237	108.790	25.587	10.749	52.429	5.069	13.224
	Nd146	75.391	40.962	19.106	6.017	34.229	1.917	7.244
	Sm147	16.856	10.454	4.468	1.658	10.041	.382	1.979
	Eu153	.416	.177	.053	.013	.050	.013	.018
	Tb159	2.690	1.931	1.000	.350	2.131	.054	.398
	Dy163	17.348	12.362	6.322	2.203	13.552	.349	2.549
	Er166	9.115	6.633	3.571	1.201	7.552	.177	1.469
	Tm169	1.426	1.040	.579	.190	1.191	.028	.233
	Yb172	9.811	7.159	3.845	1.287	8.162	.190	1.566
	Pr141	20.444	10.884	4.948	1.478	8.656	.525	1.779
	Ho165	3.440	2.564	1.300	.444	2.689	.070	.520
	Lu175	1.257	.940	.569	.177	1.101	.025	.214
	Gd158	15.066	10.718	5.029	1.796	10.458	.309	2.098
Correlation	Ti47	1.000	.642	-.174	.139	.156	.753	.454
	Mn55	.642	1.000	.185	.424	.167	.461	.482
	Zn66	-.174	.185	1.000	.739	.544	.092	.178
	Ga69	.139	.424	.739	1.000	.821	.157	.535
	Rb85	.156	.167	.544	.821	1.000	.117	.566
	Sr88	.753	.461	.092	.157	.117	1.000	.333
	Y89	.454	.482	.178	.535	.566	.333	1.000
	Zr90	.542	.378	.096	.331	.387	.530	.758
	Nb93	.519	.494	.001	.503	.610	.137	.793
	Ba137	.633	.343	.036	.047	-.010	.938	.184
	Fe57	.538	.834	.219	.502	.173	.315	.440
	Ce140	.780	.580	.119	.371	.306	.744	.689
	Nd146	.635	.501	.204	.476	.458	.645	.864
	Sm147	.560	.504	.189	.517	.531	.507	.932
	Eu153	.738	.455	.119	.217	.141	.895	.447
	Tb159	.469	.489	.221	.573	.591	.376	.983
	Dy163	.472	.488	.219	.564	.587	.379	.984
	Er166	.431	.455	.214	.533	.568	.334	.984
	Tm169	.423	.449	.218	.529	.562	.336	.978
	Yb172	.427	.402	.213	.525	.565	.331	.966
	Pr141	.672	.519	.207	.456	.453	.890	.829
	Ho165	.456	.492	.218	.552	.586	.368	.976
	Lu175	.390	.427	.222	.520	.548	.315	.947
	Gd158	.494	.510	.209	.553	.545	.405	.975

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Pooled Within-Groups Matrices[a]

		Zr90	Nb93	Ba137	Fe57	Ce140	Nd146	Sm147
Covariance	Ti47	812.220	160.017	244.572	16234.843	212.237	75.391	16.856
	Mn55	389.921	105.007	91.345	17339.843	108.790	40.962	10.454
	Zn66	112.791	.166	11.042	5199.413	25.587	19.106	4.468
	Ga69	52.740	16.505	1.932	1611.689	10.749	6.017	1.658
	Rb85	364.548	118.129	-2.362	3277.287	52.429	34.229	10.041
	Sr88	19.872	1.061	9.073	237.687	5.069	1.917	.382
	Y89	80.059	17.252	5.010	936.187	13.224	7.244	1.979
	Zr90	1107.324	127.387	114.284	6918.023	149.044	72.861	17.886
	Nb93	127.387	46.918	-.528	2191.267	23.673	11.589	3.298
	Ba137	114.284	-.528	73.833	1315.837	32.039	11.542	2.049
	Fe57	6918.023	2191.267	1315.837	449220.74	2158.332	806.803	205.713
	Ce140	149.044	23.673	32.039	2158.332	36.572	14.549	3.249
	Nd146	72.861	11.589	11.542	806.803	14.549	6.966	1.653
	Sm147	17.886	3.298	2.049	205.713	3.249	1.653	.447
	Eu153	.256	.018	.086	3.218	.064	.025	.005
	Tb159	3.296	.690	.257	37.777	.568	.302	.081
	Dy163	21.060	4.423	1.634	237.727	3.572	1.927	.515
	Er166	11.648	2.462	.781	127.256	1.943	1.064	.289
	Tm169	1.807	.384	.126	19.182	.305	.167	.045
	Yb172	12.020	2.643	.839	130.038	2.076	1.120	.305
	Pr141	18.299	2.902	3.155	203.360	3.821	1.732	.414
	Ho165	4.255	.881	.326	48.802	.722	.387	.104
	Lu175	1.565	.346	.114	17.240	.278	.150	.041
	Gd158	17.837	3.524	1.513	213.960	3.060	1.635	.435
Correlation	Ti47	.542	.519	.633	.538	.780	.635	.560
	Mn55	.378	.494	.343	.834	.580	.501	.504
	Zn66	.096	.001	.036	.219	.119	.204	.189
	Ga69	.331	.503	.047	.502	.371	.476	.517
	Rb85	.387	.610	-.010	.173	.306	.458	.531
	Sr88	.530	.137	.938	.315	.744	.645	.507
	Y89	.758	.793	.184	.440	.689	.864	.932
	Zr90	1.000	.559	.400	.310	.741	.830	.804
	Nb93	.559	1.000	-.009	.477	.571	.641	.720
	Ba137	.400	-.009	1.000	.229	.617	.510	.357
	Fe57	.310	.477	.229	1.000	.532	.456	.459
	Ce140	.741	.571	.617	.532	1.000	.912	.804
	Nd146	.830	.641	.510	.456	.912	1.000	.937
	Sm147	.804	.720	.357	.459	.804	.937	1.000
	Eu153	.614	.214	.798	.383	.848	.767	.623
	Tb159	.777	.790	.235	.442	.724	.897	.959
	Dy163	.778	.792	.233	.435	.724	.895	.946
	Er166	.745	.765	.194	.404	.680	.858	.919
	Tm169	.726	.748	.196	.382	.674	.846	.908
	Yb172	.707	.756	.191	.380	.672	.832	.893
	Pr141	.814	.627	.544	.449	.935	.971	.915
	Ho165	.761	.786	.226	.434	.711	.872	.930
	Lu175	.662	.713	.187	.362	.647	.803	.865
	Gd158	.791	.759	.260	.471	.746	.914	.961

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Pooled Within-Groups Matrices[a]

		Eu153	Tb159	Dy163	Er166	Tm169	Yb172	Pr141
Covariance	Ti47	.416	2.890	17.348	9.115	1.425	9.811	20.444
	Mn55	.177	1.931	12.352	6.633	1.040	7.159	10.884
	Zn66	.053	1.000	6.322	3.571	.579	3.845	4.948
	Ga69	.013	.350	2.203	1.201	.190	1.287	1.478
	Rb85	.060	2.131	13.552	7.562	1.191	8.162	8.696
	Sr88	.013	.054	.349	.177	.028	.190	.525
	Y89	.018	.398	2.549	1.489	.233	1.566	1.779
	Zr90	.256	3.296	21.080	11.648	1.807	12.020	18.299
	Nb93	.018	.690	4.423	2.462	.384	2.643	2.902
	Ba137	.086	.257	1.634	.781	.126	.839	3.155
	Fe57	3.218	37.777	237.727	127.255	19.182	130.036	203.360
	Ce140	.064	.558	3.572	1.943	.305	2.076	3.821
	Nd146	.025	.302	1.927	1.064	.167	1.120	1.732
	Sm147	.005	.081	.516	.289	.045	.305	.414
	Eu153	.000	.001	.005	.003	.000	.003	.007
	Tb159	.001	.016	.104	.059	.009	.062	.074
	Dy163	.005	.104	.665	.378	.060	.401	.475
	Er166	.003	.059	.378	.221	.035	.236	.262
	Tm169	.000	.009	.060	.035	.006	.038	.041
	Yb172	.003	.062	.401	.236	.038	.261	.278
	Pr141	.007	.074	.475	.262	.041	.278	.457
	Ho165	.001	.021	.135	.078	.012	.083	.096
	Lu175	.000	.008	.054	.032	.005	.036	.037
	Gd158	.005	.086	.546	.307	.048	.323	.402
Correlation	Ti47	.738	.469	.472	.431	.423	.427	.672
	Mn55	.455	.489	.488	.455	.448	.452	.519
	Zn66	.119	.221	.219	.214	.218	.213	.207
	Ga69	.217	.573	.564	.533	.529	.526	.456
	Rb85	.141	.591	.587	.568	.582	.565	.453
	Sr88	.895	.378	.379	.334	.336	.331	.690
	Y89	.447	.983	.984	.984	.978	.966	.829
	Zr90	.614	.777	.776	.745	.726	.707	.814
	Nb93	.214	.790	.792	.765	.748	.756	.627
	Ba137	.796	.235	.233	.194	.196	.191	.544
	Fe57	.383	.442	.435	.404	.382	.380	.449
	Ce140	.848	.724	.724	.683	.674	.672	.936
	Nd146	.767	.897	.895	.858	.846	.832	.971
	Sm147	.623	.960	.946	.919	.908	.893	.915
	Eu153	1.000	.491	.492	.450	.447	.436	.796
	Tb159	.491	1.000	.996	.977	.967	.950	.864
	Dy163	.492	.996	1.000	.985	.975	.962	.862
	Er166	.450	.977	.985	1.000	.992	.984	.823
	Tm169	.447	.967	.975	.992	1.000	.992	.813
	Yb172	.436	.950	.962	.984	.992	1.000	.806
	Pr141	.796	.864	.862	.823	.813	.806	1.000
	Ho165	.475	.979	.983	.983	.979	.969	.842
	Lu175	.423	.923	.935	.970	.984	.990	.775
	Gd158	.534	.990	.987	.965	.956	.933	.878

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Pooled Within-Groups Matrices[a]

		Ho165	Lu175	Gd158
Covariance	Ti47	3.440	1.257	15.066
	Mn55	2.564	.940	10.718
	Zn66	1.300	.559	5.029
	Ga69	.444	.177	1.796
	Rb85	2.686	1.101	10.458
	Sr88	.070	.025	.309
	Y89	.520	.214	2.098
	Zr90	4.255	1.565	17.807
	Nb93	.881	.346	3.524
	Ba137	.326	.114	1.513
	Fe57	48.802	17.240	213.980
	Ce140	.722	.278	3.080
	Nd146	.387	.150	1.635
	Sm147	.104	.041	.435
	Eu153	.001	.000	.005
	Tb159	.021	.008	.086
	Dy163	.136	.054	.546
	Er166	.078	.032	.307
	Tm169	.012	.005	.048
	Yb172	.083	.036	.323
	Pr141	.096	.037	.402
	Ho165	.028	.011	.110
	Lu175	.011	.005	.044
	Gd158	.110	.044	.460
Correlation	Ti47	.455	.393	.494
	Mn55	.492	.427	.510
	Zn66	.218	.222	.209
	Ga69	.552	.520	.553
	Rb85	.566	.548	.545
	Sr88	.368	.315	.405
	Y89	.976	.947	.975
	Zr90	.761	.662	.791
	Nb93	.766	.713	.759
	Ba137	.226	.187	.260
	Fe57	.434	.362	.471
	Ce140	.711	.647	.746
	Nd146	.872	.803	.914
	Sm147	.930	.865	.961
	Eu153	.475	.423	.534
	Tb159	.979	.923	.990
	Dy163	.983	.935	.987
	Er166	.983	.970	.965
	Tm169	.979	.984	.955
	Yb172	.969	.990	.933
	Pr141	.842	.775	.878
	Ho165	1.000	.952	.969
	Lu175	.952	1.000	.906
	Gd158	.969	.906	1.000

a. The covariance matrix has 235 degrees of freedom.

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Covariance Matrices[a]

V2		Ti47	Mn55	Zn66	Ga69	Rb85	Sr88	Y89
1	Ti47	709.999	376.829	-331.066	-47.623	-178.152	13.035	49.494
	Mn55	376.829	762.030	118.368	-3.690	-199.433	5.539	38.664
	Zn66	-331.066	118.368	855.106	83.149	266.764	-5.813	-7.084
	Ga69	-47.623	-3.690	83.149	10.209	33.791	-.865	-1.781
	Rb85	-178.152	-199.433	266.764	33.791	269.676	-4.845	-4.947
	Sr88	13.035	5.539	-5.813	-.865	-4.845	.738	.981
	Y89	49.494	38.664	-7.084	-1.781	-4.947	.981	6.202
	Zr90	451.716	292.145	-72.935	-18.260	-13.725	7.858	52.107
	Nb93	66.953	56.833	-3.061	-2.190	5.507	.495	7.957
	Ba137	120.949	47.771	-62.377	-9.796	-54.599	9.234	6.457
	Fe57	3348.403	11831.710	5685.648	353.714	-2248.875	46.687	348.037
	Ce140	76.903	88.097	-6.203	-2.750	-15.143	1.230	9.035
	Nd146	34.390	30.389	-2.313	-1.109	-2.737	.743	4.555
	Sm147	9.752	7.138	-1.398	-.351	-.974	.196	1.154
	Eu153	.130	.080	-.035	-.005	-.027	.003	.013
	Tb159	1.877	1.490	-.123	-.058	-.157	.043	.246
	Dy163	12.075	9.563	-.607	-.352	-.942	.256	1.566
	Er166	7.242	5.198	-.611	-.259	-.651	.148	.914
	Tm169	1.116	.856	-.101	-.035	-.098	.024	.146
	Yb172	7.382	5.844	-1.217	-.281	-.981	.159	.939
	Pr141	9.517	8.767	-1.541	-.412	-1.326	.168	1.142
	Ho165	2.442	2.066	-.072	-.070	-.253	.058	.314
	Lu175	.976	.761	-.107	-.032	-.105	.022	.126
	Gd158	10.236	8.638	.295	-.217	-.397	.198	1.357
2	Ti47	3821.996	1122.405	-984.731	-92.016	-168.869	51.319	171.835
	Mn55	1122.405	916.639	162.396	1.385	-125.510	19.058	81.389
	Zn66	-984.731	162.396	913.086	76.924	107.539	-10.543	-6.879
	Ga69	-92.016	1.385	76.924	10.280	24.340	-1.414	-.096
	Rb85	-168.869	-125.510	107.539	24.340	105.740	-3.622	-1.796
	Sr88	51.319	19.058	-10.543	-1.414	-3.622	.842	2.582
	Y89	171.835	81.389	-6.879	-.096	-1.796	2.582	10.939
	Zr90	2233.026	880.298	-246.973	-14.406	-15.413	32.510	129.360
	Nb93	211.620	123.192	12.980	1.541	-1.612	3.627	15.385
	Ba137	285.590	110.286	-53.566	-7.073	-17.854	4.910	15.459
	Fe57	30554.972	19495.533	2247.786	-67.201	-2180.342	453.857	1944.613
	Ce140	570.301	250.563	-47.043	-6.395	-20.247	8.889	33.158
	Nd146	230.867	102.767	-18.591	-2.357	-7.867	3.590	13.605
	Sm147	47.261	22.209	-2.118	-.175	-.969	.717	2.959
	Eu153	1.256	.455	-.222	-.028	-.067	.019	.063
	Tb159	6.759	3.083	-.286	-.010	-.043	.104	.431
	Dy163	42.898	20.316	-1.697	-.090	-.577	.672	2.752
	Er166	24.436	11.471	-1.018	-.034	-.264	.375	1.562
	Tm169	3.587	1.684	-.170	.008	-.052	.055	.229
	Yb172	23.560	10.725	-1.360	.104	-.411	.362	1.472
	Pr141	60.964	28.189	-2.629	-.335	-1.349	.955	3.796
	Ho165	9.484	4.275	-.689	-.059	-.237	.141	.572
	Lu175	3.443	1.539	-.248	-.007	-.025	.051	.214
	Gd158	41.663	18.969	-2.014	-.151	-.596	.638	2.599

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Covariance Matrices[a]

V2		Ti47	Mn55	Zn66	Ga69	Rb85	Sr88	Y89
3	Ti47	754.994	433.602	302.678	78.291	590.372	6.242	88.814
	Mn55	433.602	546.291	686.353	122.055	705.818	4.801	85.050
	Zn66	302.678	686.353	2016.508	305.612	1840.981	6.683	116.516
	Ga69	78.291	122.055	305.612	48.638	303.083	1.263	21.705
	Rb85	590.372	705.818	1840.981	303.083	2013.549	8.761	136.039
	Sr88	6.242	4.801	6.683	1.263	8.761	.071	1.015
	Y89	88.814	85.050	116.516	21.705	136.039	1.015	16.929
	Zr90	1229.331	1070.918	401.882	119.418	858.920	10.824	169.737
	Nb93	277.138	211.204	348.403	64.151	447.887	2.891	42.368
	Ba137	5.552	5.726	9.325	1.558	9.514	.065	1.045
	Fe57	9342.835	11860.797	18325.807	3128.893	18478.479	106.271	1841.074
	Ce140	117.639	102.915	133.471	25.683	170.778	1.236	19.389
	Nd146	59.065	52.850	69.776	13.341	84.858	.638	10.499
	Sm147	17.063	16.018	18.199	3.621	21.798	.176	3.031
	Eu153	.045	.034	.050	.010	.061	.000	.007
	Tb159	3.916	3.524	4.803	.911	5.797	.043	.707
	Dy163	26.078	22.606	30.609	6.898	38.132	.281	4.604
	Er166	14.488	13.297	17.329	3.332	21.318	.157	2.626
	Tm169	2.174	1.892	2.469	.474	3.059	.023	.382
	Yb172	15.947	13.129	17.036	3.328	22.233	.171	2.695
	Pr141	16.206	13.259	18.865	3.578	23.887	.175	2.731
	Ho165	5.191	4.580	6.018	1.176	7.596	.056	.930
	Lu175	1.928	1.630	2.278	.437	2.871	.021	.339
	Gd158	17.988	16.598	19.907	3.850	23.328	.192	3.277
4	Ti47	870.012	277.018	174.748	32.252	318.515	16.443	44.631
	Mn55	277.018	536.354	16.383	16.142	-191.284	3.755	17.916
	Zn66	174.748	16.383	1151.422	130.308	776.621	13.566	58.292
	Ga69	32.252	16.142	130.308	17.546	97.507	1.868	9.244
	Rb85	318.515	-191.284	776.621	97.507	890.507	14.851	59.035
	Sr88	16.443	3.755	13.566	1.868	14.851	.508	1.667
	Y89	44.631	17.916	58.292	9.244	59.035	1.667	6.405
	Zr90	445.150	115.342	582.152	88.591	615.942	17.085	79.978
	Nb93	66.597	33.048	78.221	12.434	78.416	2.223	10.498
	Ba137	77.778	19.852	68.650	9.634	74.052	2.343	8.369
	Fe57	4801.069	11886.510	.846	303.678	-4742.700	28.561	260.398
	Ce140	91.643	66.716	92.143	15.204	73.438	2.913	13.930
	Nd146	42.190	20.987	57.388	8.777	52.066	1.584	7.724
	Sm147	11.228	3.877	13.533	2.035	13.753	.396	1.853
	Eu153	.196	.091	.173	.026	.168	.006	.024
	Tb159	1.732	.527	2.471	.386	2.455	.068	.342
	Dy163	11.452	4.347	15.132	2.407	15.180	.439	2.190
	Er166	6.162	2.216	8.237	1.326	8.534	.240	1.227
	Tm169	1.083	.355	1.466	.231	1.473	.041	.204
	Yb172	6.970	2.388	9.479	1.481	9.350	.264	1.311
	Pr141	11.292	3.847	12.625	1.891	12.517	.401	1.786
	Ho165	2.296	.911	3.124	.501	3.130	.089	.460
	Lu175	.920	.330	1.368	.215	1.333	.036	.167
	Gd158	10.209	3.946	13.065	2.051	13.071	.374	1.841

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Covariance Matrices[a]

V2		Ti47	Mn55	Zn66	Ga69	Rb85	Sr88	Y89
5	Ti47	3083.871	637.190	-914.200	-70.038	-714.350	65.977	-12.284
	Mn55	637.190	349.903	-90.127	6.632	-58.201	8.718	-.355
	Zn66	-914.200	-90.127	873.011	88.081	564.406	-.821	24.070
	Ga69	-70.038	6.632	88.081	13.245	88.069	-.533	4.694
	Rb85	-714.350	-58.201	564.406	88.069	755.645	-12.936	47.816
	Sr88	65.977	8.718	-.821	-.533	-12.936	2.838	.025
	Y89	-12.284	-.355	24.070	4.694	47.816	.025	8.699
	Zr90	636.289	66.663	169.236	25.913	179.473	33.488	65.542
	Nb93	25.772	32.586	-40.939	4.831	70.080	-4.391	10.243
	Ba137	496.813	54.448	-22.548	-8.423	-135.364	21.529	-4.584
	Fe57	22548.580	6927.952	-4907.846	-62.711	-3621.700	342.634	-152.501
	Ce140	307.160	61.538	-19.221	-.094	-33.029	10.427	6.238
	Nd146	62.495	7.218	13.069	1.467	8.121	3.239	5.045
	Sm147	5.282	.573	5.396	.775	6.901	.418	1.535
	Eu153	.657	.067	-.003	-.008	-.148	.030	.003
	Tb159	-.398	-.110	1.046	.176	1.801	.017	.237
	Dy163	-2.477	-.735	6.551	1.143	11.754	.103	2.193
	Er166	-2.514	-.654	3.774	.683	7.281	.007	1.297
	Tm169	-.462	-.105	.606	.108	1.145	-.001	.208
	Yb172	-3.680	-.677	4.174	.735	7.802	-.031	1.390
	Pr141	18.320	3.102	4.114	.516	2.184	.911	1.237
	Ho165	-.524	-.077	1.285	.245	2.499	.013	.447
	Lu175	-.518	-.112	.595	.103	1.073	-.003	.188
	Gd158	.416	-.381	4.953	.825	8.243	.190	1.727
6	Ti47	2138.178	1482.253	317.086	78.378	552.553	51.752	60.536
	Mn55	1482.253	1446.340	313.450	48.807	148.484	39.471	40.111
	Zn66	317.086	313.450	658.207	77.480	321.025	8.509	16.011
	Ga69	78.378	48.807	77.480	14.596	78.648	1.954	3.235
	Rb85	552.553	148.484	321.025	78.648	612.653	11.347	14.089
	Sr88	51.752	39.471	8.509	1.954	11.347	1.381	1.553
	Y89	60.536	40.111	16.011	3.235	14.089	1.553	4.441
	Zr90	658.925	388.412	153.770	34.615	190.266	16.943	39.661
	Nb93	140.135	73.353	39.094	9.843	65.783	3.078	6.280
	Ba137	307.846	232.802	49.284	11.403	70.459	8.243	8.316
	Fe57	12900.453	12553.217	4275.232	518.639	476.464	347.084	584.863
	Ce140	201.867	117.282	56.152	13.152	73.391	4.805	9.383
	Nd146	70.433	39.938	21.416	4.676	24.985	1.758	3.912
	Sm147	16.092	10.216	4.010	.907	4.454	.413	.950
	Eu153	.460	.319	.104	.023	.120	.012	.018
	Tb159	2.670	1.797	.849	.170	.755	.069	.171
	Dy163	17.861	11.957	5.456	1.120	5.163	.457	1.121
	Er166	9.419	6.329	3.106	.575	2.547	.238	.647
	Tm169	1.580	1.098	.510	.098	.424	.041	.102
	Yb172	11.900	7.809	3.789	.776	3.658	.300	.723
	Pr141	20.980	12.624	6.808	1.326	7.244	.525	1.056
	Ho165	3.670	2.693	1.188	.236	.962	.095	.236
	Lu175	1.512	1.007	.471	.096	.428	.038	.096
	Gd158	13.637	8.430	4.120	.796	3.126	.354	.905

Covariance Matrices[a]

V2		Ti47	Mn55	Zn66	Ga69	Rb85	Sr88	Y89
7	Ti47	4199.603	3098.534	-3041.353	485.818	2672.441	17.762	476.659
	Mn55	3098.534	4697.069	1572.836	874.052	2990.390	16.675	414.414
	Zn66	-3041.353	1572.836	9504.768	540.856	33.943	-8.241	-239.307
	Ga69	485.818	874.052	540.856	178.283	589.376	2.522	71.102
	Rb85	2672.441	2990.390	33.943	589.376	2490.304	11.445	353.944
	Sr88	17.762	16.675	-8.241	2.522	11.445	.093	2.184
	Y89	476.659	414.414	-239.307	71.102	353.944	2.184	61.861
	Zr90	2947.064	2131.030	-2177.359	338.708	1965.339	13.053	373.763
	Nb93	1253.003	911.532	-1004.957	146.873	844.190	5.217	152.117
	Ba137	26.032	18.616	-12.009	2.769	15.136	.132	3.058
	Fe57	84319.323	145371.83	70410.549	27667.218	89236.716	472.582	11524.374
	Ce140	445.320	383.465	-269.172	63.580	318.032	2.014	56.020
	Nd146	285.893	267.397	-122.755	46.853	215.410	1.334	37.017
	Sm147	93.004	84.517	-42.716	14.867	70.019	.429	12.044
	Eu153	.394	.499	.067	.089	.321	.002	.047
	Tb159	18.823	17.633	-7.250	3.121	14.774	.087	2.492
	Dy163	115.932	107.165	-45.208	18.884	89.966	.533	15.290
	Er166	61.411	54.830	-27.167	9.518	46.621	.284	8.131
	Tm169	9.431	8.100	-4.737	1.401	7.105	.043	1.260
	Yb172	63.412	53.567	-34.523	9.032	46.222	.293	8.300
	Pr141	62.509	58.253	-28.177	9.964	47.416	.295	8.247
	Ho165	22.462	20.553	-10.120	3.502	16.779	.106	2.956
	Lu175	8.402	7.015	-4.568	1.207	6.244	.038	1.104
	Gd158	102.075	100.497	-32.012	17.879	81.249	.476	13.538
8	Ti47	4158.602	2047.739	-217.546	136.293	1177.525	49.751	167.544
	Mn55	2047.739	1363.287	316.341	116.008	751.779	23.340	103.877
	Zn66	-217.546	316.341	667.492	100.276	313.102	.160	31.678
	Ga69	136.293	116.008	100.276	19.147	87.473	2.147	11.424
	Rb85	1177.525	751.779	313.102	87.473	513.506	15.428	63.130
	Sr88	49.751	23.340	.160	2.147	15.428	.682	2.195
	Y89	167.544	103.877	31.678	11.424	63.130	2.195	13.863
	Zr90	1931.193	733.436	-193.810	53.603	527.086	26.635	39.339
	Nb93	569.726	286.139	-40.222	16.930	157.340	6.583	22.926
	Ba137	228.089	106.063	1.377	10.219	72.012	3.098	10.439
	Fe57	37548.828	27577.383	11500.137	2987.130	16741.537	452.817	2159.769
	Ce140	439.600	238.620	20.308	20.370	144.561	5.473	20.480
	Nd146	105.307	89.656	1.503	7.765	57.018	2.449	8.493
	Sm147	42.493	23.063	4.097	2.357	14.822	.577	2.275
	Eu153	.784	.386	-.018	.035	.239	.011	.037
	Tb159	7.223	3.890	.668	.398	2.487	.098	.426
	Dy163	45.610	25.190	4.406	2.575	15.747	.607	3.012
	Er166	23.478	16.215	7.033	1.996	9.982	.312	2.424
	Tm169	3.440	2.607	1.291	.330	1.554	.045	.417
	Yb172	23.573	19.248	10.371	2.441	11.204	.296	3.160
	Pr141	45.703	23.284	2.309	2.218	15.288	.605	2.122
	Ho165	7.698	5.451	2.279	.839	3.302	.101	.708
	Lu175	2.683	2.731	1.872	.379	1.531	.033	.491
	Gd158	39.887	21.190	3.173	2.113	13.531	.540	2.280

Covariance Matrices[a]

V2		Ti47	Mn55	Zn66	Ga69	Rb85	Sr88	Y89
Total	Ti47	10146.598	-673.001	-2452.238	-363.270	-2163.337	252.420	-261.856
	Mn55	-673.001	1361.512	598.209	138.112	489.249	-29.545	99.778
	Zn66	-2452.238	598.209	3488.746	483.618	2579.398	-77.574	300.671
	Ga69	-363.270	138.112	483.618	82.382	443.200	-12.943	52.983
	Rb85	-2163.337	489.249	2579.398	443.200	2845.561	-74.146	315.644
	Sr88	252.420	-29.545	-77.574	-12.943	-74.146	7.847	-10.227
	Y89	-261.856	99.778	300.671	52.983	315.644	-10.227	46.237
	Zr90	2278.772	-4.380	592.413	109.320	725.741	47.117	128.321
	Nb93	-991.983	294.935	951.862	169.542	1040.781	-38.850	141.757
	Ba137	1835.242	-248.730	-554.548	-94.757	-537.772	56.480	-74.378
	Fe57	33459.006	15993.675	27816.025	5065.232	19696.300	263.137	3198.086
	Ce140	1695.136	-199.500	-270.288	-47.186	-271.572	43.527	-32.965
	Nd146	276.088	-4.409	52.859	8.831	50.234	5.887	9.741
	Sm147	-10.484	13.798	51.896	8.920	52.483	-.979	7.904
	Eu153	3.257	-.359	-1.178	-.196	-1.232	.095	-.155
	Tb159	-9.673	3.933	13.078	2.268	13.421	-.413	1.851
	Dy163	-66.665	25.603	83.694	14.509	86.321	-2.698	12.530
	Er166	-38.439	14.042	44.873	7.811	46.619	-1.485	6.800
	Tm169	-5.489	2.098	6.509	1.138	6.822	-.210	.998
	Yb172	-34.950	13.796	41.814	7.362	44.400	-1.335	6.474
	Pr141	110.524	-9.267	-1.175	-.329	-1.680	2.654	.360
	Ho165	-13.182	5.184	16.190	2.816	16.677	-.524	2.439
	Lu175	-4.772	1.850	5.626	.990	5.897	-.179	.855
	Gd158	-43.301	19.796	68.286	11.764	68.670	-1.977	10.156

Covariance Matrices[a]

V2		Zr90	Nb93	Ba137	Fe57	Ce140	Nd146	Sm147
1	Ti47	451.716	66.953	120.949	3348.403	76.903	34.390	9.752
	Mn55	282.145	55.833	47.771	11831.710	68.097	30.389	7.138
	Zn66	-72.935	-3.061	-62.377	5685.648	-6.203	-2.313	-1.398
	Ga69	-18.250	-2.190	-9.796	353.714	-2.750	-1.109	-.351
	Rb85	-13.725	5.507	-64.599	-2248.876	-15.143	-2.737	-.974
	Sr88	7.858	.495	9.234	46.687	1.230	.743	.195
	Y89	52.107	7.957	8.457	348.037	9.035	4.555	1.164
	Zr90	465.815	73.691	65.618	2259.611	75.226	37.906	9.852
	Nb93	73.691	14.838	1.642	448.122	13.604	6.075	1.554
	Ba137	65.618	1.642	130.063	372.253	10.895	7.084	1.585
	Fe57	2259.611	448.122	372.253	245695.81	969.371	273.712	56.738
	Ce140	75.226	13.604	10.895	969.371	16.608	7.132	1.741
	Nd146	37.906	6.075	7.084	273.712	7.132	3.549	.864
	Sm147	9.852	1.554	1.585	56.738	1.741	.864	.236
	Eu153	.112	.015	.029	.672	.019	.009	.003
	Tb159	2.044	.308	.406	13.371	.350	.185	.046
	Dy163	13.118	1.998	2.393	82.593	2.294	1.171	.297
	Er166	7.748	1.166	1.331	41.975	1.296	.671	.174
	Tm169	1.215	.181	.216	7.515	.208	.108	.027
	Yb172	7.803	1.156	1.506	51.165	1.363	.695	.175
	Pr141	9.646	1.634	1.029	81.604	1.888	.878	.217
	Ho165	2.595	.392	.575	19.630	.471	.237	.060
	Lu175	1.049	.157	.209	6.674	.185	.094	.024
	Gd158	11.414	1.809	1.697	81.674	2.037	1.024	.259
2	Ti47	2233.026	211.620	285.590	30654.972	570.301	230.867	47.261
	Mn55	880.298	123.192	110.286	19495.533	250.683	102.767	22.209
	Zn66	-246.973	12.980	-53.566	2247.785	-47.043	-18.591	-2.118
	Ga69	-14.406	1.541	-7.073	-67.201	-6.395	-2.357	-.175
	Rb85	-15.413	-1.612	-17.854	-2180.342	-20.247	-7.867	-.969
	Sr88	32.510	3.627	4.910	453.857	8.869	3.590	.717
	Y89	129.360	15.385	15.459	1944.613	33.158	13.605	2.959
	Zr90	1584.416	177.825	191.979	22027.841	400.708	163.475	35.065
	Nb93	177.825	23.418	22.402	2729.556	46.569	19.087	4.136
	Ba137	191.979	22.402	29.451	2511.276	52.243	21.147	4.255
	Fe57	22027.841	2729.556	2511.276	469545.89	6039.947	2475.407	547.985
	Ce140	400.708	46.569	52.243	6039.947	106.416	43.229	9.045
	Nd146	163.475	19.087	21.147	2475.407	43.229	17.652	3.714
	Sm147	35.065	4.136	4.255	547.985	9.045	3.714	.823
	Eu153	.788	.084	.109	11.496	.211	.085	.017
	Tb159	5.113	.608	.626	74.072	1.315	.540	.118
	Dy163	32.549	3.931	4.063	474.434	8.445	3.461	.740
	Er166	18.444	2.210	2.264	269.478	4.765	1.960	.418
	Tm169	2.703	.323	.334	39.219	.699	.286	.061
	Yb172	17.443	2.084	2.179	253.921	4.534	1.861	.398
	Pr141	45.164	5.367	5.702	681.406	11.836	4.835	1.041
	Ho165	6.807	.788	.836	102.102	1.769	.724	.154
	Lu175	2.550	.299	.307	36.581	.648	.296	.067
	Gd158	30.906	3.649	3.813	456.901	8.014	3.284	.704

Covariance Matrices[a]

V2		Zr90	Nb93	Ba137	Fe57	Ce140	Nd146	Sm147
3	Ti47	1229.331	277.138	5.552	9342.836	117.639	59.065	17.063
	Mn55	1070.918	211.204	5.726	11860.797	102.916	52.850	16.018
	Zn66	401.882	348.403	9.325	18325.807	133.471	69.776	18.199
	Ga69	119.418	64.151	1.558	3128.893	25.683	13.341	3.621
	Rb85	858.920	447.887	9.514	18478.479	170.778	84.858	21.798
	Sr88	10.824	2.891	.065	108.271	1.236	.638	.176
	Y89	169.737	42.366	1.045	1941.074	19.389	10.499	3.031
	Zr90	5530.190	380.158	10.572	18574.475	208.743	109.485	30.180
	Nb93	380.158	140.870	2.821	5254.066	55.407	27.069	7.454
	Ba137	10.572	2.821	.086	137.200	1.203	.621	.178
	Fe57	18574.475	5254.066	137.200	292715.18	2332.746	1182.344	353.065
	Ce140	208.743	55.407	1.203	2332.746	24.473	12.311	3.510
	Nd146	109.485	27.069	.621	1182.344	12.311	6.702	1.917
	Sm147	30.180	7.454	.178	353.065	3.510	1.917	.592
	Eu153	.070	.021	.000	.807	.009	.005	.001
	Tb159	6.725	1.841	.043	81.972	.830	.443	.128
	Dy163	44.629	12.253	.280	532.282	5.436	2.888	.829
	Er166	27.094	6.800	.158	307.785	3.101	1.642	.475
	Tm169	3.959	.996	.023	43.470	.449	.239	.069
	Yb172	28.647	7.345	.166	303.420	3.236	1.690	.480
	Pr141	25.401	7.671	.171	311.648	3.319	1.719	.488
	Ho165	10.197	2.407	.055	105.298	1.087	.584	.167
	Lu175	3.321	.915	.021	37.991	.401	.212	.060
	Gd158	33.306	7.877	.194	376.271	3.732	2.061	.606
4	Ti47	445.150	66.597	77.778	4801.069	91.643	42.190	11.228
	Mn55	115.342	33.048	19.852	11886.510	66.716	20.987	3.877
	Zn66	582.152	78.221	68.650	.846	92.143	57.388	13.533
	Ga69	88.591	12.434	9.634	303.878	15.204	8.777	2.035
	Rb85	615.942	78.416	74.052	-4742.700	73.438	52.068	13.753
	Sr88	17.085	2.223	2.343	28.561	2.913	1.564	.396
	Y89	79.978	10.498	8.369	260.398	13.930	7.724	1.853
	Zr90	765.451	99.989	84.427	870.231	131.357	73.828	17.892
	Nb93	99.989	15.180	11.009	656.194	19.002	9.915	2.369
	Ba137	84.427	11.009	12.175	238.783	14.806	7.894	1.945
	Fe57	870.231	656.194	238.783	317925.95	1251.249	346.785	53.799
	Ce140	131.357	19.002	14.806	1251.249	28.283	13.682	3.154
	Nd146	73.828	9.915	7.894	346.785	13.682	7.421	1.744
	Sm147	17.892	2.369	1.945	53.799	3.154	1.744	.438
	Eu153	.238	.032	.030	1.525	.046	.023	.006
	Tb159	3.285	.425	.343	7.811	.675	.318	.076
	Dy163	21.048	2.710	2.216	59.081	3.696	2.040	.486
	Er166	11.780	1.511	1.223	27.160	2.053	1.140	.272
	Tm169	1.961	.260	.208	4.353	.338	.189	.045
	Yb172	12.660	1.624	1.339	28.235	2.217	1.226	.293
	Pr141	17.594	2.263	1.965	38.726	3.148	1.686	.409
	Ho165	4.411	.584	.452	11.758	.770	.425	.102
	Lu175	1.790	.229	.187	3.796	.312	.174	.041
	Gd158	17.653	2.312	1.889	57.518	3.127	1.714	.411

Covariance Matrices[a]

V2		Zr90	Nb93	Ba137	Fe57	Ce140	Nd146	Sm147
5	Ti47	839.289	25.772	496.613	22548.580	307.160	62.495	5.282
	Mn55	66.663	32.586	54.448	8927.952	61.538	7.216	.573
	Zn66	169.236	-40.939	-22.548	-4907.846	-19.221	13.059	5.396
	Ga69	25.913	4.831	-8.423	-62.711	-.094	1.467	.775
	Rb85	179.473	70.080	-135.364	-3621.700	-33.029	8.121	6.901
	Sr88	33.488	-4.391	21.529	342.634	10.427	3.239	.418
	Y89	65.542	10.243	-4.584	-152.501	6.238	5.045	1.535
	Zr90	912.960	16.454	225.490	1585.143	172.206	78.199	16.692
	Nb93	16.454	37.947	-42.257	818.906	-1.673	-.032	.915
	Ba137	225.490	-42.257	169.668	2250.112	76.309	22.704	2.518
	Fe57	1585.143	818.906	2250.112	303498.11	1952.592	165.106	-3.611
	Ce140	172.206	-1.673	76.309	1952.592	50.662	15.853	2.614
	Nd146	78.199	-.032	22.704	165.106	15.853	7.138	1.430
	Sm147	16.692	.915	2.518	-3.611	2.614	1.430	.370
	Eu153	.385	-.049	.227	2.682	.113	.037	.005
	Tb159	2.784	.346	-.037	-9.450	.306	.224	.065
	Dy163	18.033	2.302	-.287	-59.754	1.943	1.448	.420
	Er166	10.021	1.458	-.579	-40.171	.940	.788	.237
	Tm169	1.579	.236	-.110	-6.786	.145	.124	.038
	Yb172	10.251	1.617	-.926	-49.096	.876	.800	.249
	Pr141	20.470	-.108	6.384	74.902	4.421	1.627	.362
	Ho165	3.557	.509	-.130	-11.178	.379	.282	.084
	Lu175	1.400	.212	-.115	-6.815	.122	.109	.034
	Gd158	15.612	1.560	.854	-43.247	1.956	1.281	.350
6	Ti47	658.925	140.136	307.846	12900.463	201.867	70.433	16.092
	Mn55	388.412	73.353	232.802	12553.217	117.282	39.938	10.215
	Zn66	153.770	39.994	49.284	4275.232	55.152	21.416	4.010
	Ga69	34.815	9.843	11.403	518.639	13.152	4.676	.907
	Rb85	190.266	65.783	70.459	475.464	73.391	24.985	4.454
	Sr88	16.943	3.078	8.243	347.084	4.895	1.758	.413
	Y89	39.661	6.280	8.316	584.863	9.383	3.912	.950
	Zr90	403.965	62.645	94.246	5531.193	96.076	39.035	9.286
	Nb93	62.645	15.948	17.259	878.276	20.658	7.320	1.583
	Ba137	94.246	17.259	50.817	1975.584	27.954	9.890	2.287
	Fe57	5531.193	878.276	1975.584	180534.92	1459.841	556.856	139.381
	Ce140	96.076	20.658	27.954	1459.841	30.663	11.010	2.439
	Nd146	39.035	7.320	9.890	556.856	11.010	4.295	.948
	Sm147	9.286	1.583	2.287	139.381	2.439	.948	.244
	Eu153	.189	.034	.069	3.463	.054	.020	.005
	Tb159	1.567	.271	.375	24.776	.409	.164	.038
	Dy163	10.378	1.801	2.493	160.871	2.681	1.073	.250
	Er166	5.858	.986	1.279	91.015	1.443	.595	.140
	Tm169	.933	.159	.221	14.761	.236	.096	.022
	Yb172	6.766	1.215	1.643	103.719	1.790	.707	.165
	Pr141	10.709	2.098	2.960	163.178	3.143	1.166	.266
	Ho165	2.143	.364	.512	35.202	.553	.223	.052
	Lu175	.883	.153	.209	13.575	.228	.092	.021
	Gd158	8.330	1.371	1.918	132.792	2.101	.848	.202

Covariance Matrices[a]

V2		Zr90	Nb93	Ba137	Fe57	Ce140	Nd146	Sm147
7	Ti47	2947.054	1253.003	26.032	84319.323	445.320	265.893	93.004
	Mn55	2131.030	911.532	18.616	145371.83	383.465	267.397	84.517
	Zn66	-2177.359	-1004.957	-12.003	70410.549	-259.172	-122.755	-42.716
	Ga69	338.708	146.873	2.769	27667.218	63.580	45.853	14.567
	Rb85	1965.339	844.190	15.136	89236.716	318.032	216.410	70.019
	Sr88	13.053	5.217	.132	472.682	2.014	1.334	.429
	Y89	373.763	152.117	3.058	11524.374	56.020	37.017	12.044
	Zr90	2359.083	940.879	19.661	55668.852	339.354	220.286	71.996
	Nb93	940.879	408.157	8.331	24491.767	142.873	90.787	29.560
	Ba137	19.661	8.331	.342	492.320	2.554	1.780	.604
	Fe57	55668.852	24491.767	492.320	4610244.5	10677.110	7572.718	2392.069
	Ce140	339.354	142.873	2.554	10677.110	52.364	33.911	11.021
	Nd146	220.286	90.787	1.780	7572.718	33.911	22.432	7.273
	Sm147	71.996	29.560	.604	2392.069	11.021	7.273	2.379
	Eu153	.252	.104	.000	15.253	.043	.030	.010
	Tb159	14.801	6.029	.122	498.885	2.245	1.497	.487
	Dy163	91.218	36.968	.755	3012.615	13.768	9.177	2.979
	Er166	49.013	19.634	.414	1526.053	7.305	4.861	1.582
	Tm169	7.638	3.054	.064	223.919	1.127	.750	.245
	Yb172	50.595	20.359	.424	1477.322	7.506	4.952	1.617
	Pr141	48.267	20.288	.385	1647.765	7.584	4.994	1.625
	Ho165	17.759	7.136	.154	578.436	2.686	1.782	.582
	Lu175	6.715	2.718	.056	193.358	.996	.657	.215
	Gd158	79.606	32.412	.660	2870.675	12.234	8.194	2.658
8	Ti47	1951.193	569.726	228.089	37548.828	439.600	185.307	42.493
	Mn55	733.436	286.139	106.060	27577.383	238.620	89.656	23.063
	Zn66	-193.810	-40.222	1.377	11500.137	20.308	1.503	4.097
	Ga69	53.603	16.930	10.219	2987.130	20.370	7.765	2.357
	Rb85	527.095	157.340	72.012	16741.537	144.961	57.018	14.822
	Sr88	26.635	6.583	3.098	452.817	5.473	2.440	.577
	Y89	39.339	22.926	10.439	2159.769	20.480	8.493	2.275
	Zr90	1385.663	250.897	119.526	13402.623	197.879	92.501	19.693
	Nb93	250.897	79.630	30.123	5169.080	60.075	24.746	5.685
	Ba137	119.526	30.123	14.485	2147.728	25.167	11.119	2.645
	Fe57	13402.623	5169.080	2147.728	623231.67	4734.610	1704.308	474.320
	Ce140	197.879	60.075	25.167	4734.610	49.325	20.328	4.937
	Nd146	92.501	24.746	11.119	1704.308	20.328	8.987	2.102
	Sm147	19.693	5.685	2.645	474.320	4.937	2.102	.527
	Eu153	.394	.106	.050	7.605	.087	.038	.009
	Tb159	3.043	.969	.452	79.143	.836	.359	.090
	Dy163	16.461	6.184	2.838	510.554	5.343	2.273	.580
	Er166	2.327	3.245	1.520	363.198	3.058	1.229	.352
	Tm169	-.144	.483	.224	67.661	.466	.182	.055
	Yb172	-3.663	3.373	1.499	426.434	3.286	1.251	.387
	Pr141	22.840	6.121	2.798	472.792	5.145	2.200	.531
	Ho165	1.266	1.074	.483	119.067	.997	.388	.112
	Lu175	-1.394	.392	.178	63.575	.420	.148	.052
	Gd158	17.490	5.358	2.492	425.504	4.585	1.980	.492

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Covariance Matrices[a]

V2		Zr90	Nb93	Ba137	Fe57	Ce140	Nd146	Sm147
Total	Ti47	2278.772	-991.983	1835.242	33459.006	1695.136	276.086	-10.484
	Mn55	-4.380	294.935	-248.730	15993.675	-199.500	-4.409	13.798
	Zn66	502.413	951.862	-554.548	27616.025	-270.288	52.859	51.896
	Ga69	109.320	169.542	-94.757	5065.232	-47.186	8.831	8.920
	Rb85	725.741	1040.781	-537.772	19696.300	-271.572	50.234	52.483
	Sr88	47.117	-38.850	55.480	263.137	43.527	5.887	-.979
	Y89	128.321	141.757	-74.378	3198.086	-32.965	9.741	7.904
	Zr90	1898.565	280.858	342.565	21998.253	485.683	159.975	35.575
	Nb93	280.858	479.540	-276.419	9579.128	-140.552	18.488	23.505
	Ba137	342.565	-276.419	414.313	1988.212	319.529	43.273	-6.889
	Fe57	21998.253	9579.128	1988.212	977525.41	6520.755	2507.152	796.656
	Ce140	485.683	-140.552	319.529	6520.755	320.298	57.799	.994
	Nd146	159.975	18.488	43.273	2507.152	57.799	17.008	3.226
	Sm147	35.575	23.505	-6.889	796.656	.994	3.226	1.561
	Eu153	.504	-.594	.680	1.989	.547	.069	-.017
	Tb159	5.886	6.033	-2.904	143.578	-1.164	.469	.343
	Dy163	36.695	38.790	-19.382	693.908	-8.004	2.877	2.186
	Er166	19.097	20.802	-10.762	480.919	-4.732	1.459	1.165
	Tm169	2.849	3.018	-1.535	65.359	-.664	.220	.171
	Yb172	18.616	19.529	-9.797	426.089	-4.185	1.446	1.103
	Pr141	45.295	-2.475	19.412	849.501	21.765	5.023	.576
	Ho165	7.103	7.482	-3.783	172.695	-1.589	.552	.423
	Lu175	2.411	2.582	-1.317	56.832	-.573	.190	.147
	Gd158	33.979	31.144	-14.056	818.673	-4.458	2.822	1.838

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Covariance Matrices[a]

V2		Eu153	Tb159	Dy163	Er166	Tm169	Yb172	Pr141
1	Ti47	.130	1.877	12.075	7.242	1.115	7.382	9.517
	Mn55	.080	1.490	9.563	5.198	.856	5.844	8.767
	Zn66	-.035	-.123	-.807	-.811	-.101	-1.217	-1.541
	Ga69	-.005	-.055	-.352	-.259	-.035	-.281	-.412
	Rb85	-.027	-.157	-.942	-.851	-.098	-.981	-1.326
	Sr88	.003	.043	.256	.148	.024	.159	.158
	Y89	.013	.246	1.566	.914	.146	.939	1.142
	Zr90	.112	2.044	13.118	7.748	1.215	7.803	9.646
	Nb93	.015	.308	1.998	1.188	.181	1.155	1.634
	Ba137	.029	.406	2.393	1.331	.216	1.506	1.529
	Fe57	.672	13.371	82.593	41.975	7.515	51.165	81.604
	Ce140	.019	.360	2.294	1.206	.208	1.363	1.888
	Nd146	.009	.185	1.171	.671	.108	.695	.878
	Sm147	.003	.046	.297	.174	.027	.175	.217
	Eu153	4.16E-005	.001	.003	.002	.000	.002	.002
	Tb159	.001	.010	.064	.037	.006	.038	.045
	Dy163	.003	.064	.408	.237	.038	.241	.291
	Er166	.002	.037	.237	.139	.022	.140	.167
	Tm169	.000	.006	.038	.022	.004	.022	.027
	Yb172	.002	.038	.241	.140	.022	.146	.174
	Pr141	.002	.045	.291	.167	.027	.174	.228
	Ho165	.001	.013	.082	.047	.008	.048	.059
	Lu175	.000	.005	.033	.019	.003	.020	.023
	Gd158	.003	.055	.353	.204	.032	.207	.255
2	Ti47	1.255	6.759	42.898	24.436	3.587	23.560	60.964
	Mn55	.455	3.083	20.318	11.471	1.684	10.725	28.189
	Zn66	-.222	-.285	-1.697	-1.016	-.170	-1.360	-2.629
	Ga69	-.028	-.010	-.090	-.034	-.008	-.104	-.335
	Rb85	-.067	-.043	-.577	-.264	-.062	-.411	-1.349
	Sr88	.019	.104	.672	.375	.055	.362	.955
	Y89	.063	.431	2.752	1.562	.229	1.472	3.796
	Zr90	.788	5.113	32.549	18.444	2.703	17.443	45.104
	Nb93	.084	.608	3.931	2.210	.323	2.064	5.367
	Ba137	.106	.626	4.063	2.264	.334	2.179	5.702
	Fe57	11.486	74.072	474.434	269.478	39.219	253.921	681.406
	Ce140	.211	1.315	8.445	4.766	.699	4.534	11.838
	Nd146	.085	.540	3.461	1.950	.286	1.861	4.835
	Sm147	.017	.116	.740	.418	.061	.398	1.041
	Eu153	.000	.002	.016	.009	.001	.009	.023
	Tb159	.002	.017	.109	.062	.009	.059	.151
	Dy163	.016	.109	.701	.397	.058	.375	.962
	Er166	.009	.062	.397	.226	.033	.213	.543
	Tm169	.001	.009	.058	.033	.005	.031	.080
	Yb172	.009	.059	.375	.213	.031	.202	.515
	Pr141	.023	.151	.962	.543	.080	.515	1.347
	Ho165	.003	.023	.145	.082	.012	.078	.200
	Lu175	.001	.008	.054	.031	.004	.029	.074
	Gd158	.016	.103	.659	.374	.055	.354	.912

Covariance Matrices[a]

V2		Eu153	Tb159	Dy163	Er166	Tm169	Yb172	Pr141
3	Ti47	.045	3.915	26.078	14.488	2.174	15.947	16.205
	Mn55	.034	3.524	22.606	13.297	1.892	13.129	13.259
	Zn66	.050	4.803	30.839	17.326	2.469	17.036	18.865
	Ga69	.010	.911	5.898	3.332	.474	3.328	3.578
	Rb85	.061	5.797	38.132	21.318	3.059	22.233	23.887
	Sr88	.000	.043	.281	.157	.023	.171	.175
	Y89	.007	.707	4.604	2.026	.382	2.695	2.731
	Zr90	.070	6.725	44.629	27.094	3.959	28.647	25.401
	Nb93	.021	1.841	12.253	6.800	.996	7.345	7.671
	Ba137	.000	.043	.280	.158	.023	.166	.171
	Fe57	.807	81.972	532.282	307.785	43.470	303.420	311.648
	Ce140	.009	.830	5.438	3.101	.449	3.236	3.318
	Nd146	.005	.443	2.888	1.642	.239	1.690	1.719
	Sm147	.001	.128	.829	.475	.069	.480	.488
	Eu153	6.18E-006	.000	.002	.001	.000	.001	.001
	Tb159	.000	.030	.196	.111	.016	.114	.117
	Dy163	.002	.196	1.286	.729	.106	.753	.768
	Er166	.001	.111	.729	.417	.060	.426	.433
	Tm169	.000	.016	.106	.060	.009	.062	.063
	Yb172	.001	.114	.753	.426	.062	.448	.455
	Pr141	.001	.117	.768	.433	.063	.455	.470
	Ho165	.000	.039	.258	.147	.021	.152	.153
	Lu175	.000	.014	.094	.053	.008	.056	.057
	Gd158	.001	.138	.897	.512	.076	.519	.525
4	Ti47	.106	1.732	11.452	6.162	1.063	6.970	11.292
	Mn55	.091	.627	4.347	2.216	.355	2.388	3.847
	Zn66	.173	2.471	15.132	8.237	1.466	9.479	12.625
	Ga69	.026	.386	2.407	1.326	.231	1.481	1.891
	Rb85	.168	2.455	15.180	8.534	1.473	9.350	12.517
	Sr88	.006	.068	.439	.240	.041	.264	.401
	Y89	.024	.342	2.190	1.227	.204	1.311	1.786
	Zr90	.238	3.285	21.048	11.780	1.961	12.660	17.594
	Nb93	.032	.425	2.710	1.511	.250	1.624	2.263
	Ba137	.030	.343	2.216	1.223	.208	1.339	1.955
	Fe57	1.525	7.811	59.081	27.160	4.353	28.235	38.726
	Ce140	.046	.575	3.696	2.053	.338	2.217	3.148
	Nd146	.023	.318	2.040	1.140	.189	1.226	1.686
	Sm147	.006	.076	.486	.272	.045	.293	.409
	Eu153	9.38E-005	.001	.006	.004	.001	.004	.006
	Tb159	.001	.014	.090	.051	.008	.054	.074
	Dy163	.006	.090	.583	.326	.054	.349	.473
	Er166	.004	.051	.326	.183	.030	.195	.264
	Tm169	.001	.008	.054	.030	.005	.033	.044
	Yb172	.004	.054	.349	.195	.033	.211	.286
	Pr141	.006	.074	.473	.264	.044	.286	.418
	Ho165	.001	.019	.122	.068	.011	.073	.099
	Lu175	.001	.008	.050	.028	.005	.030	.040
	Gd158	.005	.076	.486	.272	.045	.292	.399

Covariance Matrices[a]

V2		Eu153	Tb159	Dy163	Er166	Tm169	Yb172	Pr141
5	Ti47	.657	-.398	-2.477	-2.514	-.462	-3.880	18.320
	Mn55	.067	-.110	-.735	-.654	-.105	-.877	3.102
	Zn66	-.003	1.046	6.551	3.774	.606	4.174	4.114
	Ga69	-.008	.176	1.143	.683	.108	.735	.516
	Rb85	-.148	1.801	11.754	7.281	1.145	7.802	2.184
	Sr88	.030	.017	.103	.007	-.001	-.031	.911
	Y89	.003	.337	2.193	1.297	.208	1.390	1.237
	Zr90	.385	2.784	18.033	10.021	1.579	10.251	20.470
	Nb93	-.049	.346	2.302	1.458	.236	1.617	-.108
	Ba137	.227	-.037	-.287	-.579	-.110	-.926	6.384
	Fe57	2.682	-9.450	-59.754	-40.171	-6.788	-40.056	74.902
	Ce140	.113	.306	1.943	.946	.145	.876	4.421
	Nd146	.037	.224	1.448	.788	.124	.800	1.827
	Sm147	.005	.065	.420	.237	.038	.248	.362
	Eu153	.000	.000	.002	.001	7.57E-005	.000	.010
	Tb159	.000	.014	.089	.052	.008	.055	.055
	Dy163	.002	.089	.577	.338	.054	.360	.353
	Er166	.001	.052	.338	.201	.032	.213	.190
	Tm169	7.57E-005	.008	.054	.032	.005	.034	.030
	Yb172	.000	.055	.360	.213	.034	.230	.194
	Pr141	.010	.055	.353	.190	.030	.194	.405
	Ho165	.000	.018	.117	.069	.011	.073	.069
	Lu175	4.98E-005	.008	.049	.029	.005	.031	.026
	Gd158	.003	.071	.459	.266	.043	.283	.317
6	Ti47	.460	2.670	17.861	9.419	1.580	11.900	20.980
	Mn55	.319	1.797	11.957	6.329	1.098	7.809	12.624
	Zn66	.104	.849	5.456	3.106	.510	3.789	5.808
	Ga69	.023	.170	1.120	.575	.096	.776	1.328
	Rb85	.120	.755	5.163	2.547	.424	3.658	7.244
	Sr88	.012	.069	.457	.238	.041	.300	.525
	Y89	.018	.171	1.121	.647	.102	.723	1.056
	Zr90	.189	1.587	10.378	5.858	.933	6.766	10.709
	Nb93	.034	.271	1.801	.986	.158	1.215	2.098
	Ba137	.069	.375	2.493	1.279	.221	1.643	2.980
	Fe57	3.463	24.776	160.871	91.015	14.761	103.719	163.178
	Ce140	.054	.409	2.681	1.443	.236	1.790	3.143
	Nd146	.020	.164	1.073	.595	.096	.707	1.168
	Sm147	.005	.038	.250	.140	.022	.165	.266
	Eu153	.000	.001	.005	.003	.000	.003	.006
	Tb159	.001	.007	.045	.026	.004	.029	.045
	Dy163	.005	.045	.299	.168	.027	.194	.294
	Er166	.003	.026	.168	.098	.015	.109	.160
	Tm169	.000	.004	.027	.015	.002	.018	.026
	Yb172	.003	.029	.194	.109	.018	.129	.195
	Pr141	.006	.045	.294	.160	.026	.195	.337
	Ho165	.001	.010	.063	.036	.006	.041	.061
	Lu175	.000	.004	.025	.014	.002	.017	.025
	Gd158	.004	.036	.237	.134	.022	.154	.233

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Covariance Matrices[a]

V2		Eu153	Tb159	Dy163	Er166	Tm169	Yb172	Pr141
7	Ti47	.394	18.923	115.932	61.411	9.431	63.412	62.509
	Mn55	.499	17.633	107.165	54.830	8.100	53.567	58.253
	Zn66	.057	-7.250	-45.208	-27.167	-4.737	-34.523	-28.177
	Ga69	.089	3.121	18.884	9.518	1.401	9.032	9.964
	Rb85	.321	14.774	89.966	46.621	7.105	46.222	47.416
	Sr88	.002	.087	.533	.284	.043	.293	.295
	Y89	.047	2.492	15.290	8.131	1.260	8.300	8.247
	Zr90	.252	14.801	91.218	49.013	7.638	50.595	49.267
	Nb93	.104	6.029	36.958	19.634	3.054	20.359	20.288
	Ba137	.003	.122	.755	.414	.064	.424	.385
	Fe57	15.253	498.885	3012.615	1526.063	223.919	1477.322	1647.765
	Ce140	.043	2.245	13.768	7.305	1.127	7.506	7.584
	Nd146	.030	1.497	9.177	4.881	.750	4.952	4.994
	Sm147	.010	.487	2.979	1.582	.245	1.617	1.625
	Eu153	6.10E-005	.002	.012	.006	.001	.006	.006
	Tb159	.002	.101	.620	.328	.051	.333	.333
	Dy163	.012	.620	3.806	2.018	.312	2.046	2.041
	Er166	.006	.328	2.018	1.074	.167	1.094	1.085
	Tm169	.001	.051	.312	.167	.026	.170	.168
	Yb172	.006	.333	2.046	1.094	.170	1.121	1.109
	Pr141	.006	.333	2.041	1.085	.168	1.109	1.122
	Ho165	.002	.119	.731	.390	.060	.398	.399
	Lu175	.001	.044	.273	.146	.023	.149	.147
	Gd158	.011	.552	3.380	1.786	.275	1.806	1.820
8	Ti47	.784	7.223	45.610	23.478	3.440	23.573	45.703
	Mn55	.398	3.890	25.100	16.215	2.607	19.248	23.284
	Zn66	-.018	.668	4.406	7.033	1.291	10.371	2.309
	Ga69	.035	.398	2.575	1.996	.330	2.441	2.218
	Rb85	.239	2.487	15.747	9.882	1.554	11.204	15.286
	Sr88	.011	.098	.607	.312	.045	.296	.605
	Y89	.037	.428	3.012	2.424	.417	3.160	2.122
	Zr90	.394	3.043	16.461	2.327	-.144	-3.653	22.840
	Nb93	.104	.969	6.184	3.245	.483	3.373	6.121
	Ba137	.050	.452	2.838	1.520	.224	1.499	2.798
	Fe57	7.605	79.143	510.554	353.198	57.661	426.434	472.792
	Ce140	.087	.836	5.343	3.058	.466	3.296	5.145
	Nd146	.038	.359	2.273	1.229	.182	1.251	2.200
	Sm147	.009	.090	.580	.352	.055	.387	.531
	Eu153	.000	.002	.010	.006	.001	.006	.010
	Tb159	.002	.016	.105	.069	.011	.080	.090
	Dy163	.010	.105	.709	.500	.083	.609	.567
	Er166	.006	.069	.500	.442	.078	.599	.313
	Tm169	.001	.011	.083	.078	.014	.109	.047
	Yb172	.006	.080	.609	.599	.109	.848	.320
	Pr141	.010	.090	.567	.313	.047	.320	.558
	Ho165	.002	.021	.149	.127	.022	.169	.101
	Lu175	.001	.011	.089	.096	.018	.140	.039
	Gd158	.009	.087	.564	.360	.057	.411	.496

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Covariance Matrices[a]

V2		Eu153	Tb159	Dy163	Er166	Tm169	Yb172	Pr141
Total	Ti47	3.257	-9.973	-66.865	-38.439	-5.489	-34.950	110.524
	Mn55	-.359	3.933	25.603	14.042	2.098	13.796	-8.257
	Zn66	-1.178	13.078	83.694	44.873	6.509	41.814	-1.175
	Ga69	-.196	2.268	14.509	7.811	1.138	7.382	-.329
	Rb85	-1.232	13.421	86.321	46.619	6.822	44.400	-1.680
	Sr88	.096	-.413	-2.698	-1.485	-.210	-1.335	2.654
	Y89	-.155	1.951	12.530	6.800	.998	6.474	.380
	Zr90	.504	5.686	36.685	19.097	2.849	18.616	45.295
	Nb93	-.594	6.033	38.790	20.802	3.018	19.529	-2.475
	Ba137	.680	-2.954	-19.382	-10.762	-1.535	-9.797	19.412
	Fe57	1.989	143.578	893.908	460.919	66.359	426.089	649.501
	Ce140	.547	-1.164	-8.004	-4.732	-.684	-4.165	21.765
	Nd146	.069	.469	2.877	1.459	.220	1.446	5.023
	Sm147	-.017	.343	2.186	1.165	.171	1.103	.576
	Eu153	.001	-.006	-.041	-.023	-.003	-.021	.030
	Tb159	-.006	.083	.535	.288	.042	.272	.030
	Dy163	-.041	.535	3.431	1.850	.271	1.753	.172
	Er166	-.023	.288	1.850	1.008	.148	.961	.062
	Tm169	-.003	.042	.271	.148	.022	.142	.011
	Yb172	-.021	.272	1.753	.961	.142	.930	.083
	Pr141	.033	.033	.172	.062	.011	.083	1.681
	Ho165	-.008	.104	.666	.361	.053	.343	.031
	Lu175	-.003	.036	.234	.129	.019	.125	.010
	Gd158	-.030	.437	2.791	1.497	.219	1.411	.298

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Covariance Matrices[a]

V2		Ho165	Lu175	Gd158
1	Ti47	2.442	.976	10.236
	Mn55	2.066	.781	8.638
	Zn66	-.072	-.107	.296
	Ga69	-.070	-.032	-.217
	Rb85	-.253	-.105	-.337
	Sr88	.058	.022	.198
	Y89	.314	.126	1.357
	Zr90	2.595	1.049	11.414
	Nb93	.392	.157	1.809
	Ba137	.575	.209	1.697
	Fe57	19.630	6.674	81.874
	Ce140	.471	.185	2.037
	Nd146	.237	.094	1.024
	Sm147	.060	.024	.259
	Eu153	.001	.000	.003
	Tb159	.013	.005	.055
	Dy163	.082	.033	.353
	Er166	.047	.019	.204
	Tm169	.008	.003	.032
	Yb172	.048	.020	.207
	Pr141	.059	.023	.255
	Ho165	.017	.007	.071
	Lu175	.007	.003	.028
	Gd158	.071	.028	.310
2	Ti47	9.484	3.443	41.683
	Mn55	4.275	1.539	18.969
	Zn66	-.689	-.248	-2.014
	Ga69	-.059	-.007	-.151
	Rb85	-.237	-.025	-.596
	Sr88	.141	.051	.638
	Y89	.572	.214	2.599
	Zr90	6.807	2.550	30.906
	Nb93	.789	.299	3.649
	Ba137	.836	.307	3.813
	Fe57	102.102	36.581	456.901
	Ce140	1.769	.648	8.014
	Nd146	.724	.266	3.284
	Sm147	.154	.057	.704
	Eu153	.003	.001	.015
	Tb159	.023	.008	.103
	Dy163	.145	.054	.659
	Er166	.082	.031	.374
	Tm169	.012	.004	.055
	Yb172	.078	.029	.354
	Pr141	.200	.074	.912
	Ho165	.030	.011	.137
	Lu175	.011	.004	.051
	Gd158	.137	.051	.623

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Covariance Matrices[a]

V2		Ho165	Lu175	Gd158
3	Ti47	5.191	1.928	17.966
	Mn55	4.580	1.630	16.598
	Zn66	6.018	2.278	19.907
	Ga69	1.176	.437	3.850
	Rb85	7.596	2.871	23.328
	Sr88	.056	.021	.192
	Y89	.930	.339	3.277
	Zr90	10.197	3.321	33.306
	Nb93	2.407	.915	7.877
	Ba137	.055	.021	.194
	Fe57	105.298	37.991	375.271
	Ce140	1.067	.401	3.732
	Nd146	.564	.212	2.061
	Sm147	.167	.060	.606
	Eu153	.000	.000	.001
	Tb159	.039	.014	.138
	Dy163	.258	.094	.897
	Er166	.147	.053	.512
	Tm169	.021	.008	.075
	Yb172	.152	.058	.519
	Pr141	.153	.057	.525
	Ho165	.053	.019	.180
	Lu175	.019	.007	.065
	Gd158	.180	.065	.601
4	Ti47	2.298	.920	10.209
	Mn55	.911	.330	3.948
	Zn66	3.124	1.368	13.085
	Ga69	.501	.215	2.051
	Rb85	3.130	1.333	13.071
	Sr88	.089	.036	.374
	Y89	.460	.187	1.841
	Zr90	4.411	1.790	17.650
	Nb93	.564	.229	2.312
	Ba137	.452	.187	1.889
	Fe57	11.758	3.796	57.518
	Ce140	.770	.312	3.127
	Nd146	.425	.174	1.714
	Sm147	.102	.041	.411
	Eu153	.001	.001	.005
	Tb159	.019	.008	.076
	Dy163	.122	.050	.486
	Er166	.068	.028	.272
	Tm169	.011	.005	.045
	Yb172	.073	.030	.292
	Pr141	.099	.040	.399
	Ho165	.026	.010	.102
	Lu175	.010	.004	.041
	Gd158	.102	.041	.410

Covariance Matrices[a]

V2		Ho165	Lu175	Gd158
5	Ti47	-.524	-.518	.416
	Mn55	-.077	-.112	-.381
	Zn66	1.285	.595	4.953
	Ga69	.245	.103	.825
	Rb85	2.499	1.073	8.243
	Sr88	.013	-.003	.190
	Y89	.447	.188	1.727
	Zr90	3.557	1.400	15.612
	Nb93	.509	.212	1.560
	Ba137	-.130	-.115	.664
	Fe57	-11.178	-6.815	-43.247
	Ce140	.379	.122	1.996
	Nd146	.282	.109	1.281
	Sm147	.088	.034	.350
	Eu153	.000	4.98E-005	.003
	Tb159	.018	.008	.071
	Dy163	.117	.049	.459
	Er166	.069	.029	.265
	Tm169	.011	.005	.043
	Yb172	.073	.031	.283
	Pr141	.069	.026	.317
	Ho165	.024	.010	.093
	Lu175	.010	.004	.038
	Gd158	.093	.038	.374
6	Ti47	3.670	1.512	13.537
	Mn55	2.603	1.007	9.430
	Zn66	1.188	.471	4.120
	Ga69	.236	.095	.796
	Rb85	.962	.428	3.126
	Sr88	.095	.038	.354
	Y89	.235	.096	.905
	Zr90	2.143	.883	8.330
	Nb93	.364	.153	1.371
	Ba137	.512	.209	1.918
	Fe57	35.202	13.575	132.792
	Ce140	.553	.228	2.101
	Nd146	.223	.092	.848
	Sm147	.052	.021	.202
	Eu153	.001	.000	.004
	Tb159	.010	.004	.036
	Dy163	.063	.025	.237
	Er166	.036	.014	.134
	Tm169	.006	.002	.022
	Yb172	.041	.017	.154
	Pr141	.061	.025	.233
	Ho165	.014	.005	.050
	Lu175	.005	.002	.020
	Gd158	.050	.020	.193

Covariance Matrices[a]

V2		Ho165	Lu175	Gd158
7	Ti47	22.462	8.402	102.075
	Mn55	20.553	7.015	100.497
	Zn66	-10.120	-4.568	-32.012
	Ga69	3.502	1.207	17.879
	Rb85	16.779	6.244	81.249
	Sr88	.106	.038	.476
	Y89	2.956	1.104	13.538
	Zr90	17.759	6.715	79.606
	Nb93	7.136	2.718	32.412
	Ba137	.154	.055	.660
	Fe57	578.436	199.356	2870.675
	Ce140	2.686	.996	12.234
	Nd146	1.782	.657	8.194
	Sm147	.582	.215	2.658
	Eu153	.002	.001	.011
	Tb159	.119	.044	.552
	Dy163	.731	.273	3.380
	Er166	.390	.146	1.786
	Tm169	.060	.023	.275
	Yb172	.398	.149	1.806
	Pr141	.399	.147	1.820
	Ho165	.143	.053	.662
	Lu175	.053	.020	.240
	Gd158	.652	.240	3.027
8	Ti47	7.088	2.683	39.887
	Mn55	5.451	2.731	21.100
	Zn66	2.279	1.872	3.173
	Ga69	.639	.379	2.113
	Rb85	3.302	1.531	13.531
	Sr88	.101	.033	.540
	Y89	.708	.491	2.280
	Zr90	1.266	-1.394	17.490
	Nb93	1.074	.392	5.358
	Ba137	.483	.178	2.492
	Fe57	119.067	63.575	425.504
	Ce140	.997	.420	4.585
	Nd146	.388	.148	1.980
	Sm147	.112	.052	.492
	Eu153	.002	.001	.009
	Tb159	.021	.011	.087
	Dy163	.149	.089	.564
	Er166	.127	.096	.360
	Tm169	.022	.018	.057
	Yb172	.169	.140	.411
	Pr141	.101	.039	.496
	Ho165	.038	.027	.112
	Lu175	.027	.024	.057
	Gd158	.112	.067	.473

Covariance Matrices[a]

V2		Ho165	Lu175	Gd158
Total	Ti47	-13.182	-4.772	-43.301
	Mn55	5.184	1.850	19.795
	Zn66	18.190	5.826	68.286
	Ga69	2.816	.990	11.754
	Rb85	15.677	5.897	68.670
	Sr88	-.524	-.179	-1.977
	Y89	2.439	.865	10.156
	Zr90	7.103	2.411	33.979
	Nb93	7.482	2.582	31.144
	Ba137	-3.783	-1.317	-14.058
	Fe57	172.695	56.832	818.673
	Ce140	-1.589	-.573	-4.458
	Nd146	.552	.190	2.822
	Sm147	.423	.147	1.808
	Eu153	-.008	-.003	-.030
	Tb159	.104	.036	.437
	Dy163	.666	.234	2.791
	Er166	.361	.129	1.497
	Tm169	.053	.019	.219
	Yb172	.343	.125	1.411
	Pr141	.031	.010	.298
	Ho165	.130	.046	.541
	Lu175	.046	.017	.188
	Gd158	.541	.188	2.306

a. The total covariance matrix has 242 degrees of freedom.

Analysis 1

Box's Test of Equality of Covariance Matrices

Log Determinants

V2	Rank	Log Determinant
1	16	5.071
2	a	b
3	16	-16.721
4	16	6.413
5	16	13.048
6	16	5.475
7	c	b
8	c	b
Pooled within-groups	16	20.488

The ranks and natural logarithms of determinants printed are those of the group covariance matrices.

a. Rank < 9

b. Too few cases to be non-singular

c. Rank < 10

Test Results[a]

Box's M		3444.779
F	Approx.	4.900
	df1	544
	df2	20186.137
	Sig.	.000

Tests null hypothesis of equal population covariance matrices.

a. Some covariance matrices are singular and the usual procedure will not work. The non-singular groups will be tested against their own pooled within-groups covariance matrix. The log of its determinant is 22.364.

Stepwise Statistics

Variables Entered/Removed[a,b,c,d]

Step	Entered	Wilks' Lambda			
		Statistic	df1	df2	df3
1	Nb93	.095	1	7	235.000
2	Ce140	.008	2	7	235.000
3	Eu153	.002	3	7	235.000
4	Sr88	.001	4	7	235.000
5	Mn55	.001	5	7	235.000
6	Fe57	.000	6	7	235.000
7	Ti47	.000	7	7	235.000
8	Ba137	.000	8	7	235.000
9	Pr141	.000	9	7	235.000
10	Gd158	.000	10	7	235.000
11	Y89	.000	11	7	235.000
12	Nd146	.000	12	7	235.000
13	Rb85	.000	13	7	235.000
14	Zn66	.000	14	7	235.000
15	Ga69	.000	15	7	235.000
16	Sm147	.000	16	7	235.000

At each step, the variable that minimizes the overall Wilks' Lambda is entered.

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Variables Entered/Removed[a,b,c,d]

Step	Wilks' Lambda							
	Exact F				Approximate F			
	Statistic	df1	df2	Sig.	Statistic	df1	df2	Sig.
1	319.778	7	235.000	.000				
2	337.063	14	468.000	.000				
3					228.780	21	669.600	.000
4					176.607	28	837.910	.000
5					133.849	35	974.159	.000
6					124.666	42	1082.249	.000
7					107.761	49	1167.616	.000
8					96.612	56	1233.129	.000
9					87.928	63	1284.584	.000
10					79.819	70	1324.612	.000
11					77.463	77	1355.738	.000
12					72.696	84	1379.908	.000
13					67.663	91	1398.604	.000
14					66.811	98	1412.972	.000
15					64.755	105	1423.885	.000
16					61.081	112	1432.017	.000

At each step, the variable that minimizes the overall Wilks' Lambda is entered.

a. Maximum number of steps is 48.

b. Minimum partial F to enter is 3.84.

c. Maximum partial F to remove is 2.71.

d. F level, tolerance, or VIN insufficient for further computation.

Variables in the Analysis

Step		Tolerance	F to Remove	Wilks' Lambda
1	Nb93	1.000	319.778	
2	Nb93	.673	421.863	.111
	Ce140	.673	356.698	.095
3	Nb93	.412	136.450	.012
	Ce140	.121	292.929	.024
	Eu153	.171	79.722	.008
4	Nb93	.406	136.216	.005
	Ce140	.121	238.337	.008
	Eu153	.104	109.444	.004
	Sr88	.198	50.867	.002
5	Nb93	.377	93.167	.002
	Ce140	.119	174.271	.004
	Eu153	.103	81.380	.002
	Sr88	.187	54.612	.002
	Mn55	.691	18.131	.001
6	Nb93	.376	86.916	.001
	Ce140	.118	125.196	.001
	Eu153	.102	82.350	.001
	Sr88	.172	56.760	.001
	Mn55	.239	48.870	.001
	Fe57	.271	45.932	.001

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Variables in the Analysis

Step		Tolerance	F to Remove	Wilks' Lambda
7	Nb93	.316	108.257	.001
	Ce140	.117	92.243	.001
	Eu153	.101	75.436	.001
	Sr88	.143	71.184	.001
	Mn55	.234	47.275	.000
	Fe57	.270	45.307	.000
	Ti47	.232	16.168	.000
8	Nb93	.300	111.898	.001
	Ce140	.117	92.363	.000
	Eu153	.095	72.700	.000
	Sr88	.045	38.000	.000
	Mn55	.225	45.642	.000
	Fe57	.263	45.964	.000
	Ti47	.231	15.677	.000
	Ba137	.090	15.395	.000
9	Nb93	.191	47.039	.000
	Ce140	.068	45.473	.000
	Eu153	.087	32.412	.000
	Sr88	.042	42.512	.000
	Mn55	.224	45.155	.000
	Fe57	.257	45.641	.000
	Ti47	.163	23.701	.000
	Ba137	.088	16.824	.000
	Pr141	.066	13.185	.000
10	Nb93	.163	15.078	.000
	Ce140	.057	29.831	.000
	Eu153	.086	31.420	.000
	Sr88	.041	42.208	.000
	Mn55	.220	46.258	.000
	Fe57	.254	40.490	.000
	Ti47	.159	19.462	.000
	Ba137	.087	15.633	.000
	Pr141	.033	12.056	.000
	Gd158	.098	8.263	.000
11	Nb93	.155	15.172	.000
	Ce140	.056	29.750	.000
	Eu153	.084	32.567	.000
	Sr88	.040	28.782	.000
	Mn55	.220	41.198	.000
	Fe57	.253	38.087	.000
	Ti47	.159	16.390	.000
	Ba137	.086	8.942	.000
	Pr141	.033	11.989	.000
	Gd158	.030	26.053	.000
	Y89	.038	19.371	.000

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Variables in the Analysis

Step		Tolerance	F to Remove	Wilks' Lambda
12	Nb93	.155	15.083	.000
	Ce140	.047	34.681	.000
	Eu153	.081	23.893	.000
	Sr88	.040	26.857	.000
	Mn55	.211	43.239	.000
	Fe57	.253	34.800	.000
	Ti47	.155	16.596	.000
	Ba137	.085	8.602	.000
	Pr141	.031	7.797	.000
	Gd158	.024	28.437	.000
	Y89	.038	18.857	.000
	Nd146	.027	9.170	.000
13	Nb93	.115	18.823	.000
	Ce140	.045	34.803	.000
	Eu153	.081	23.785	.000
	Sr88	.036	26.649	.000
	Mn55	.206	40.287	.000
	Fe57	.249	33.200	.000
	Ti47	.138	18.462	.000
	Ba137	.081	9.150	.000
	Pr141	.031	6.337	.000
	Gd158	.024	27.146	.000
	Y89	.037	18.839	.000
	Nd146	.027	9.147	.000
	Rb85	.431	5.462	.000
14	Nb93	.095	25.601	.000
	Ce140	.044	35.702	.000
	Eu153	.081	22.804	.000
	Sr88	.036	26.081	.000
	Mn55	.186	46.966	.000
	Fe57	.236	21.770	.000
	Ti47	.115	16.868	.000
	Ba137	.081	9.198	.000
	Pr141	.031	6.175	.000
	Gd158	.024	19.259	.000
	Y89	.037	10.525	.000
	Nd146	.027	9.098	.000
	Rb85	.199	18.387	.000
	Zn66	.256	16.479	.000

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Variables in the Analysis

Step		Tolerance	F to Remove	Wilks' Lambda
15	Nb93	.094	25.477	.000
	Ce140	.042	37.888	.000
	Eu153	.081	15.862	.000
	Sr88	.036	25.978	.000
	Mn55	.185	47.047	.000
	Fe57	.184	12.480	.000
	Ti47	.104	17.882	.000
	Ba137	.081	9.117	.000
	Pr141	.029	6.740	.000
	Gd158	.023	19.138	.000
	Y89	.036	11.112	.000
	Nd146	.027	8.906	.000
	Rb85	.102	12.622	.000
	Zn66	.214	18.603	.000
	Ga69	.085	10.639	.000
16	Nb93	.094	25.229	.000
	Ce140	.042	35.926	.000
	Eu153	.081	15.753	.000
	Sr88	.036	26.230	.000
	Mn55	.185	46.833	.000
	Fe57	.182	12.703	.000
	Ti47	.104	17.883	.000
	Ba137	.080	9.252	.000
	Pr141	.029	6.642	.000
	Gd158	.020	13.671	.000
	Y89	.036	11.073	.000
	Nd146	.026	7.704	.000
	Rb85	.100	13.382	.000
	Zn66	.210	17.314	.000
	Ga69	.085	10.279	.000
	Sm147	.050	3.844	.000

Variables Not in the Analysis

Step		Tolerance	Min. Tolerance	F to Enter	Wilks' Lambda
0	Ti47	1.000	1.000	139.479	.194
	Mn55	1.000	1.000	15.392	.686
	Zn66	1.000	1.000	62.497	.349
	Ga69	1.000	1.000	90.473	.271
	Rb85	1.000	1.000	89.303	.273
	Sr88	1.000	1.000	174.623	.161
	Y89	1.000	1.000	124.953	.212
	Zr90	1.000	1.000	25.703	.566
	Nb93	1.000	1.000	319.778	.095
	Ba137	1.000	1.000	160.952	.173
	Fe57	1.000	1.000	41.658	.446
	Ce140	1.000	1.000	269.203	.111
	Nd146	1.000	1.000	50.854	.398
	Sm147	1.000	1.000	87.179	.278
	Eu153	1.000	1.000	257.761	.115

Variables Not in the Analysis

Step		Tolerance	Min. Tolerance	F to Enter	Wilks' Lambda
0	Tb159	1.000	1.000	144.107	.189
	Dy163	1.000	1.000	144.645	.188
	Er166	1.000	1.000	124.093	.213
	Tm169	1.000	1.000	101.120	.249
	Yb172	1.000	1.000	89.729	.272
	Pr141	1.000	1.000	93.675	.264
	Ho165	1.000	1.000	126.018	.210
	Lu175	1.000	1.000	82.170	.290
	Gd158	1.000	1.000	139.880	.194
1	Ti47	.731	.731	154.685	.017
	Mn55	.756	.756	22.504	.057
	Zn66	1.000	1.000	10.447	.072
	Ga69	.747	.747	11.605	.071
	Rb85	.629	.629	6.707	.079
	Sr88	.981	.981	90.908	.026
	Y89	.371	.371	8.446	.080
	Zr90	.688	.688	44.966	.041
	Ba137	1.000	1.000	85.766	.027
	Fe57	.772	.772	44.592	.041
	Ce140	.673	.673	356.698	.008
	Nd146	.589	.589	103.325	.023
	Sm147	.481	.481	31.992	.049
	Eu153	.954	.954	101.720	.024
	Tb159	.376	.376	9.400	.074
	Dy163	.373	.373	7.144	.078
	Er166	.415	.415	6.058	.080
	Tm169	.440	.440	6.119	.080
	Yb172	.429	.429	7.909	.077
	Pr141	.607	.607	173.723	.015
	Ho165	.413	.413	6.341	.080
	Lu175	.492	.492	7.741	.077
	Gd158	.424	.424	16.597	.083

Variables Not in the Analysis

Step		Tolerance	Min Tolerance	F to Enter	Wilks' Lambda
2	Ti47	.384	.354	11.902	.006
	Mn55	.624	.556	31.533	.004
	Zn66	.979	.659	11.333	.006
	Ga69	.737	.575	12.141	.006
	Rb85	.626	.465	6.570	.007
	Sr88	.324	.222	33.296	.004
	Y89	.289	.289	14.623	.006
	Zr90	.424	.415	8.906	.006
	Ba137	.424	.286	22.819	.005
	Fe57	.672	.586	20.579	.005
	Nd146	.148	.148	32.616	.004
	Sm147	.253	.253	23.148	.005
	Eu153	.171	.121	79.722	.002
	Tb159	.266	.266	16.636	.005
	Dy163	.264	.264	15.972	.006
	Er166	.325	.325	13.753	.006
	Tm169	.350	.350	13.144	.006
	Yb172	.343	.343	14.876	.006
	Pr141	.113	.113	21.493	.005
	Ho165	.303	.303	15.526	.006
	Lu175	.407	.407	14.281	.006
	Gd158	.279	.279	21.537	.005
3	Ti47	.319	.121	7.805	.002
	Mn55	.619	.119	15.886	.002
	Zn66	.978	.120	11.268	.002
	Ga69	.736	.121	9.547	.002
	Rb85	.608	.117	7.623	.002
	Sr88	.198	.104	50.867	.001
	Y89	.285	.119	4.959	.002
	Zr90	.415	.116	2.700	.002
	Ba137	.331	.120	33.043	.001
	Fe57	.672	.118	18.106	.002
	Nd146	.137	.096	12.841	.002
	Sm147	.241	.116	12.474	.002
	Tb159	.261	.118	6.903	.002
	Dy163	.259	.118	6.421	.002
	Er166	.322	.118	5.409	.002
	Tm169	.348	.119	5.243	.002
	Yb172	.342	.118	7.044	.002
	Pr141	.104	.085	6.956	.002
	Ho165	.301	.117	6.367	.002
	Lu175	.408	.118	6.621	.002
	Gd158	.272	.118	11.473	.002

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Variables Not in the Analysis

Step		Tolerance	Min Tolerance	F to Enter	Wilks' Lambda
4	Ti47	.254	.103	18.882	.001
	Mn55	.591	.103	18.131	.001
	Zn66	.977	.104	11.248	.001
	Ga69	.734	.103	9.542	.001
	Rb85	.604	.103	3.991	.001
	Y89	.281	.101	5.159	.001
	Zr90	.415	.102	2.684	.001
	Ba137	.095	.056	16.375	.001
	Fe57	.672	.104	16.293	.001
	Nd146	.136	.095	9.575	.001
	Sm147	.239	.098	10.109	.001
	Tb159	.258	.101	6.205	.001
	Dy163	.256	.100	6.253	.001
	Er166	.317	.101	5.860	.001
	Tm169	.343	.102	5.662	.001
	Yb172	.339	.102	7.332	.001
	Pr141	.104	.085	5.055	.001
	Ho165	.298	.102	6.247	.001
	Lu175	.401	.102	7.052	.001
	Gd158	.264	.098	9.758	.001
5	Ti47	.233	.102	16.507	.000
	Zn66	.944	.103	12.704	.000
	Ga69	.701	.103	10.686	.000
	Rb85	.573	.103	3.779	.001
	Y89	.281	.101	5.145	.001
	Zr90	.400	.102	2.651	.001
	Ba137	.093	.053	15.583	.000
	Fe57	.271	.102	45.932	.000
	Nd146	.130	.091	10.666	.000
	Sm147	.238	.096	9.973	.000
	Tb159	.257	.100	6.084	.001
	Dy163	.255	.100	6.200	.001
	Er166	.316	.101	5.835	.001
	Tm169	.343	.101	5.723	.001
	Yb172	.338	.102	7.390	.000
	Pr141	.099	.081	5.974	.001
	Ho165	.298	.102	6.218	.001
	Lu175	.401	.102	7.089	.001
	Gd158	.264	.098	9.452	.000

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Variables Not in the Analysis

Step		Tolerance	Min. Tolerance	F to Enter	Wilks' Lambda
6	Ti47	.232	.101	16.168	.000
	Zn66	.932	.102	6.973	.000
	Ga69	.653	.102	2.279	.000
	Rb85	.673	.101	3.671	.000
	Y89	.279	.099	5.121	.000
	Zr90	.393	.101	1.767	.000
	Ba137	.091	.049	15.883	.000
	Nd146	.130	.090	9.953	.000
	Sm147	.237	.097	10.061	.000
	Tb159	.255	.099	6.330	.000
	Dy163	.251	.098	6.400	.000
	Er166	.311	.099	6.039	.000
	Tm169	.333	.100	5.747	.000
	Yb172	.326	.100	6.995	.000
	Pr141	.096	.078	6.042	.000
	Ho165	.293	.100	6.424	.000
	Lu175	.390	.100	7.297	.000
	Gd158	.263	.098	9.543	.000
7	Zn66	.609	.100	8.382	.000
	Ga69	.442	.099	4.889	.000
	Rb85	.469	.100	6.990	.000
	Y89	.215	.096	1.542	.000
	Zr90	.380	.099	1.518	.000
	Ba137	.090	.046	15.398	.000
	Nd146	.092	.083	12.058	.000
	Sm147	.189	.092	11.212	.000
	Tb159	.176	.094	6.153	.000
	Dy163	.175	.093	4.542	.000
	Er166	.237	.096	1.949	.000
	Tm169	.258	.096	1.532	.000
	Yb172	.257	.098	2.369	.000
	Pr141	.069	.069	11.850	.000
	Ho165	.216	.097	3.481	.000
	Lu175	.316	.098	2.632	.000
	Gd158	.197	.091	10.220	.000
8	Zn66	.576	.041	10.627	.000
	Ga69	.426	.041	5.443	.000
	Rb85	.443	.039	6.976	.000
	Y89	.213	.045	1.624	.000
	Zr90	.376	.045	1.843	.000
	Nd146	.092	.045	11.147	.000
	Sm147	.185	.044	11.205	.000
	Tb159	.176	.045	5.775	.000
	Dy163	.174	.045	4.552	.000
	Er166	.237	.045	1.976	.000
	Tm169	.257	.045	1.348	.000
	Yb172	.257	.045	1.795	.000
	Pr141	.066	.042	13.185	.000
	Ho165	.215	.045	3.579	.000
	Lu175	.315	.045	2.380	.000
	Gd158	.196	.045	9.283	.000

Variables Not in the Analysis

Step		Tolerance	Min. Tolerance	F to Enter	Wilks' Lambda
9	Zn66	.568	.038	7.212	.000
	Ga69	.425	.038	4.844	.000
	Rb85	.435	.037	6.849	.000
	Y89	.123	.039	3.607	.000
	Zr90	.325	.042	1.327	.000
	Nd146	.049	.036	4.456	.000
	Sm147	.102	.037	6.663	.000
	Tb159	.087	.033	4.189	.000
	Dy163	.092	.035	3.919	.000
	Er166	.151	.041	4.617	.000
	Tm169	.175	.042	4.227	.000
	Yb172	.183	.042	5.676	.000
	Ho165	.137	.042	3.419	.000
	Lu175	.249	.041	5.159	.000
	Gd158	.098	.033	8.263	.000
10	Zn66	.563	.032	7.571	.000
	Ga69	.425	.033	4.799	.000
	Rb85	.433	.033	5.439	.000
	Y89	.038	.030	19.371	.000
	Zr90	.290	.033	1.083	.000
	Nd146	.027	.027	9.559	.000
	Sm147	.053	.032	4.215	.000
	Tb159	.012	.012	9.276	.000
	Dy163	.017	.017	8.626	.000
	Er166	.059	.033	11.334	.000
	Tm169	.076	.033	13.472	.000
	Yb172	.111	.033	11.876	.000
	Ho165	.053	.033	5.878	.000
	Lu175	.164	.033	9.276	.000
11	Zn66	.557	.030	3.979	.000
	Ga69	.419	.030	4.898	.000
	Rb85	.432	.030	5.470	.000
	Zr90	.290	.029	.911	.000
	Nd146	.027	.024	9.170	.000
	Sm147	.053	.025	4.399	.000
	Tb159	.010	.010	3.346	.000
	Dy163	.012	.012	1.814	.000
	Er166	.028	.018	1.996	.000
	Tm169	.037	.018	1.458	.000
	Yb172	.059	.020	2.001	.000
	Ho165	.038	.027	1.119	.000
	Lu175	.083	.019	3.009	.000

Variables Not in the Analysis

Step		Tolerance	Min. Tolerance	F to Enter	Wilks' Lambda
12	Zn66	.556	.024	4.040	.000
	Ga69	.416	.024	4.603	.000
	Rb85	.431	.024	5.462	.000
	Zr90	.285	.024	.967	.000
	Sm147	.051	.021	3.174	.000
	Tb159	.010	.010	3.249	.000
	Dy163	.012	.012	1.690	.000
	Er166	.028	.018	1.567	.000
	Tm169	.036	.018	1.068	.000
	Yb172	.057	.019	1.613	.000
	Ho165	.037	.022	1.297	.000
	Lu175	.081	.019	2.526	.000
13	Zn66	.256	.024	15.479	.000
	Ga69	.103	.023	10.513	.000
	Zr90	.284	.024	1.031	.000
	Sm147	.051	.021	3.156	.000
	Tb159	.009	.009	3.316	.000
	Dy163	.012	.012	1.945	.000
	Er166	.027	.017	1.903	.000
	Tm169	.036	.017	1.175	.000
	Yb172	.056	.019	1.999	.000
	Ho165	.037	.022	1.646	.000
	Lu175	.077	.018	3.401	.000
14	Ga69	.085	.023	10.639	.000
	Zr90	.283	.024	.727	.000
	Sm147	.050	.021	4.127	.000
	Tb159	.009	.009	3.628	.000
	Dy163	.011	.011	2.422	.000
	Er166	.025	.016	2.231	.000
	Tm169	.032	.016	2.093	.000
	Yb172	.053	.018	2.231	.000
	Ho165	.037	.022	1.349	.000
	Lu175	.075	.017	2.437	.000
15	Zr90	.280	.022	.943	.000
	Sm147	.050	.020	3.844	.000
	Tb159	.009	.009	2.698	.000
	Dy163	.011	.011	2.324	.000
	Er166	.025	.016	2.766	.000
	Tm169	.032	.016	1.979	.000
	Yb172	.053	.018	1.911	.000
	Ho165	.037	.021	1.187	.000
	Lu175	.074	.017	1.735	.000
16	Zr90	.280	.020	.898	.000
	Tb159	.009	.009	2.690	.000
	Dy163	.011	.011	2.365	.000
	Er166	.025	.016	2.600	.000
	Tm169	.032	.016	1.728	.000
	Yb172	.053	.018	1.824	.000
	Ho165	.037	.018	1.146	.000
	Lu175	.074	.017	1.727	.000

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Wilks' Lambda

Step	Number of Variables	Lambda	df1	df2	df3
1	1	.095	1	7	236
2	2	.008	2	7	236
3	3	.002	3	7	236
4	4	.001	4	7	236
5	5	.001	5	7	235
6	6	.000	6	7	235
7	7	.000	7	7	236
8	8	.000	8	7	236
9	9	.000	9	7	236
10	10	.000	10	7	236
11	11	.000	11	7	235
12	12	.000	12	7	235
13	13	.000	13	7	235
14	14	.000	14	7	235
15	15	.000	15	7	235
16	16	.000	16	7	236

Wilks' Lambda

Step	Exact F				Approximate F			
	Statistic	df1	df2	Sig.	Statistic	df1	df2	Sig.
1	319.778	7	236.000	.000				
2	337.063	14	468.000	.000				
3					228.780	21	669.600	.000
4					176.507	28	837.910	.000
5					133.849	35	974.159	.000
6					124.666	42	1082.248	.000
7					107.761	49	1167.016	.000
8					96.512	56	1233.129	.000
9					87.928	63	1284.584	.000
10					79.819	70	1324.612	.000
11					77.463	77	1356.738	.000
12					72.696	84	1379.906	.000
13					67.663	91	1398.604	.000
14					66.811	98	1412.972	.000
15					64.755	105	1423.885	.000
16					61.081	112	1432.017	.000

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Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p]

Step	V2		1	2	3	4	5	6
1	1	F		44.183	909.376	3.092	.823	1.054
		Sig.		.000	.000	.080	.365	.306
	2	F	44.183		778.562	63.618	40.912	58.088
		Sig.	.000		.000	.000	.000	.000
	3	F	909.376	778.562		929.591	1099.732	1025.091
		Sig.	.000	.000		.000	.000	.000
	4	F	3.092	63.618	929.591		9.145	.830
		Sig.	.080	.000	.000		.003	.363
	5	F	.823	40.912	1099.732	9.145		5.140
		Sig.	.365	.000	.000	.003		.024
	6	F	1.054	58.088	1025.091	.830	5.140	
		Sig.	.306	.000	.000	.363	.024	
	7	F	792.987	759.771	8.507	789.553	909.022	849.437
		Sig.	.000	.000	.004	.000	.000	.000
	8	F	5.112	13.424	807.035	12.193	3.218	9.257
		Sig.	.025	.000	.000	.001	.074	.003
2	1	F		874.725	574.997	472.208	646.082	524.428
		Sig.		.000	.000	.000	.000	.000
	2	F	874.725		1587.947	311.407	244.746	314.575
		Sig.	.000		.000	.000	.000	.000
	3	F	574.997	1587.947		1308.324	1575.209	1414.575
		Sig.	.000	.000		.000	.000	.000
	4	F	472.208	311.407	1308.324		16.727	.457
		Sig.	.000	.000	.000		.000	.634
	5	F	646.082	244.746	1575.209	16.727		14.740
		Sig.	.000	.000	.000	.000		.000
	6	F	524.428	314.575	1414.575	.457	14.740	
		Sig.	.000	.000	.000	.634	.000	
	7	F	505.747	1413.481	5.817	1020.643	1199.782	1080.426
		Sig.	.000	.000	.003	.000	.000	.000
	8	F	14.629	454.805	432.896	116.394	161.001	121.677
		Sig.	.000	.000	.000	.000	.000	.000
3	1	F		876.788	475.079	724.264	837.193	800.348
		Sig.		.000	.000	.000	.000	.000
	2	F	876.788		1129.790	233.730	194.084	236.419
		Sig.	.000		.000	.000	.000	.000
	3	F	475.079	1129.790		904.699	1077.432	977.912
		Sig.	.000	.000		.000	.000	.000
	4	F	724.264	233.730	904.699		11.594	.307
		Sig.	.000	.000	.000		.000	.580
	5	F	837.193	194.084	1077.432	11.594		10.401
		Sig.	.000	.000	.000	.000		.000
	6	F	800.348	236.419	977.912	.307	10.401	
		Sig.	.000	.000	.000	.580	.000	
	7	F	359.944	1042.896	11.598	742.720	856.887	785.473
		Sig.	.000	.000	.000	.000	.000	.000
	8	F	14.992	554.385	374.237	319.737	342.669	333.612
		Sig.	.000	.000	.000	.000	.000	.000
4	1	F		702.106	430.903	555.878	648.658	616.838
		Sig.		.000	.000	.000	.000	.000

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Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p]

Step	V2		1	2	3	4	5	6
4	2	F	702.106		1002.339	265.459	248.193	274.451
		Sig.	.000		.000	.000	.000	.000
	3	F	430.903	1002.339		713.122	835.334	766.877
		Sig.	.000	.000		.000	.000	.000
	4	F	555.878	265.459	713.122		9.564	.359
		Sig.	.000	.000	.000		.000	.837
	5	F	648.658	248.193	835.334	9.564		8.189
		Sig.	.000	.000	.000	.000		.000
	6	F	616.838	274.451	766.877	.359	8.189	
		Sig.	.000	.000	.000	.837	.000	
	7	F	318.834	903.844	8.678	577.930	658.615	608.781
		Sig.	.000	.000	.000	.000	.000	.000
	8	F	11.278	443.222	325.660	246.720	267.486	256.597
		Sig.	.000	.000	.000	.000	.000	.000
5	1	F		611.405	407.654	539.766	655.512	588.357
		Sig.		.000	.000	.000	.000	.000
	2	F	611.405		799.015	213.260	197.812	221.317
		Sig.	.000		.000	.000	.000	.000
	3	F	407.654	799.015		568.398	665.897	611.810
		Sig.	.000	.000		.000	.000	.000
	4	F	539.766	213.260	568.398		11.079	.547
		Sig.	.000	.000	.000		.000	.741
	5	F	655.512	197.812	665.897	11.079		12.802
		Sig.	.000	.000	.000	.000		.000
	6	F	588.357	221.317	611.810	.547	12.802	
		Sig.	.000	.000	.000	.741	.000	
	7	F	282.971	722.777	8.199	461.014	528.200	485.218
		Sig.	.000	.000	.000	.000	.000	.000
	8	F	12.574	372.597	277.863	216.228	243.948	223.912
		Sig.	.000	.000	.000	.000	.000	.000
6	1	F		562.676	377.037	532.786	629.668	562.574
		Sig.		.000	.000	.000	.000	.000
	2	F	562.676		668.151	180.816	168.587	190.481
		Sig.	.000		.000	.000	.000	.000
	3	F	377.037	668.151		472.247	552.932	507.635
		Sig.	.000	.000		.000	.000	.000
	4	F	532.786	180.816	472.247		9.243	1.754
		Sig.	.000	.000	.000		.000	.109
	5	F	629.668	168.587	552.932	9.243		11.512
		Sig.	.000	.000	.000	.000		.000
	6	F	562.574	190.481	507.635	1.754	11.512	
		Sig.	.000	.000	.000	.109	.000	
	7	F	359.865	606.974	36.659	414.084	472.033	443.172
		Sig.	.000	.000	.000	.000	.000	.000
	8	F	16.628	326.253	238.365	191.041	213.422	193.794
		Sig.	.000	.000	.000	.000	.000	.000
7	1	F		587.684	354.485	469.004	566.553	503.348
		Sig.		.000	.000	.000	.000	.000
	2	F	587.684		755.170	224.499	200.644	226.579
		Sig.	.000		.000	.000	.000	.000

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Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p]

Step	V2		1	2	3	4	5	6
7	3	F	354.485	755.170		485.501	580.877	533.714
		Sig.	.000	.000		.000	.000	.000
	4	F	469.004	224.499	485.501		10.747	2.428
		Sig.	.000	.000	.000		.000	.020
	5	F	566.553	200.644	580.877	10.747		10.456
		Sig.	.000	.000	.000	.000		.000
	6	F	503.348	226.579	533.714	2.428	10.456	
		Sig.	.000	.000	.000	.020	.000	
	7	F	330.418	868.749	31.293	409.252	475.586	444.813
		Sig.	.000	.000	.000	.000	.000	.000
	8	F	15.220	364.593	213.046	175.392	202.619	182.418
		Sig.	.000	.000	.000	.000	.000	.000
8	1	F		513.201	312.695	421.139	499.914	449.892
		Sig.		.000	.000	.000	.000	.000
	2	F	513.201		663.815	196.704	174.946	198.160
		Sig.	.000		.000	.000	.000	.000
	3	F	312.695	663.815		447.173	522.993	488.013
		Sig.	.000	.000		.000	.000	.000
	4	F	421.139	196.704	447.173		10.921	2.254
		Sig.	.000	.000	.000		.000	.025
	5	F	499.914	174.946	522.993	10.921		9.990
		Sig.	.000	.000	.000	.000		.000
	6	F	449.892	198.160	488.013	2.254	9.990	
		Sig.	.000	.000	.000	.025	.000	
	7	F	289.991	586.818	27.285	371.147	424.233	401.084
		Sig.	.000	.000	.000	.000	.000	.000
	8	F	21.193	319.336	201.809	153.183	178.324	159.629
		Sig.	.000	.000	.000	.000	.000	.000
9	1	F		465.348	280.356	375.422	446.828	404.998
		Sig.		.000	.000	.000	.000	.000
	2	F	465.348		607.071	194.207	177.683	201.414
		Sig.	.000		.000	.000	.000	.000
	3	F	280.356	607.071		396.224	462.990	431.887
		Sig.	.000	.000		.000	.000	.000
	4	F	375.422	194.207	396.224		9.870	2.993
		Sig.	.000	.000	.000		.000	.002
	5	F	446.828	177.683	462.990	9.870		9.149
		Sig.	.000	.000	.000	.000		.000
	6	F	404.998	201.414	431.887	2.993	9.149	
		Sig.	.000	.000	.000	.002	.000	
	7	F	257.124	530.102	24.779	328.584	375.819	356.803
		Sig.	.000	.000	.000	.000	.000	.000
	8	F	20.908	297.725	178.609	135.769	157.854	141.281
		Sig.	.000	.000	.000	.000	.000	.000
10	1	F		423.721	291.604	336.633	400.374	362.976
		Sig.		.000	.000	.000	.000	.000
	2	F	423.721		592.587	179.703	166.495	187.040
		Sig.	.000		.000	.000	.000	.000
	3	F	291.604	592.587		405.672	461.943	438.044
		Sig.	.000	.000		.000	.000	.000

Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p]

Step	V2		1	2	3	4	5	6
10	4	F	336.633	179.703	405.672		9.122	2.745
		Sig.	.000	.000	.000		.000	.003
	5	F	400.374	166.495	461.943	9.122		8.287
		Sig.	.000	.000	.000	.000		.000
	6	F	362.976	187.040	438.044	2.745	8.287	
		Sig.	.000	.000	.000	.003	.000	
	7	F	259.977	515.963	22.230	330.036	369.592	354.067
		Sig.	.000	.000	.000	.000	.000	.000
	8	F	19.675	275.117	175.116	123.413	142.520	128.054
		Sig.	.000	.000	.000	.000	.000	.000
11	1	F		386.880	327.740	304.933	364.151	328.844
		Sig.		.000	.000	.000	.000	.000
	2	F	386.880		553.203	165.166	151.911	171.816
		Sig.	.000		.000	.000	.000	.000
	3	F	327.740	553.203		431.857	474.858	464.452
		Sig.	.000	.000		.000	.000	.000
	4	F	304.933	165.166	431.857		9.081	2.487
		Sig.	.000	.000	.000		.000	.006
	5	F	364.151	151.911	474.858	9.081		8.343
		Sig.	.000	.000	.000	.000		.000
	6	F	328.844	171.816	464.452	2.487	8.343	
		Sig.	.000	.000	.000	.006	.000	
	7	F	285.970	483.677	20.335	346.575	378.317	371.862
		Sig.	.000	.000	.000	.000	.000	.000
	8	F	19.288	255.056	208.701	114.236	133.538	118.615
		Sig.	.000	.000	.000	.000	.000	.000
12	1	F		362.127	315.754	300.459	374.574	331.618
		Sig.		.000	.000	.000	.000	.000
	2	F	362.127		504.893	150.763	139.326	156.850
		Sig.	.000		.000	.000	.000	.000
	3	F	315.754	504.893		394.406	433.939	423.856
		Sig.	.000	.000		.000	.000	.000
	4	F	300.459	150.763	394.406		11.727	2.859
		Sig.	.000	.000	.000		.000	.001
	5	F	374.574	139.326	433.939	11.727		8.990
		Sig.	.000	.000	.000	.000		.000
	6	F	331.618	156.850	423.856	2.859	8.990	
		Sig.	.000	.000	.000	.001	.000	
	7	F	282.490	442.793	19.866	321.181	345.749	341.186
		Sig.	.000	.000	.000	.000	.000	.000
	8	F	18.847	235.279	194.646	107.875	130.811	113.886
		Sig.	.000	.000	.000	.000	.000	.000
13	1	F		347.941	304.071	282.404	356.500	313.084
		Sig.		.000	.000	.000	.000	.000
	2	F	347.941		503.074	144.642	131.745	149.675
		Sig.	.000		.000	.000	.000	.000
	3	F	304.071	503.074		397.905	444.915	429.639
		Sig.	.000	.000		.000	.000	.000
	4	F	282.404	144.642	397.905		11.846	2.714
		Sig.	.000	.000	.000		.000	.001

Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p]

Step	V2		1	2	3	4	5	6
13	5	F	356.500	131.745	444.915	11.846		8.891
		Sig.	.000	.000	.000	.000		.000
	6	F	313.084	149.675	429.639	2.714	8.891	
		Sig.	.000	.000	.000	.001	.000	
	7	F	267.234	435.618	18.340	315.421	344.217	336.131
		Sig.	.000	.000	.000	.000	.000	.000
	8	F	17.507	228.653	184.637	103.468	127.497	109.889
		Sig.	.000	.000	.000	.000	.000	.000
14	1	F		321.675	356.283	261.067	330.263	290.088
		Sig.		.000	.000	.000	.000	.000
	2	F	321.675		506.678	133.775	121.888	138.448
		Sig.	.000		.000	.000	.000	.000
	3	F	356.283	506.678		450.456	511.259	498.868
		Sig.	.000	.000		.000	.000	.000
	4	F	261.067	133.775	450.456		12.071	3.587
		Sig.	.000	.000	.000		.000	.000
	5	F	330.263	121.888	511.259	12.071		8.221
		Sig.	.000	.000	.000	.000		.000
	6	F	290.088	138.448	498.868	3.587	8.221	
		Sig.	.000	.000	.000	.000	.000	
	7	F	317.111	448.000	18.134	365.987	405.256	398.636
		Sig.	.000	.000	.000	.000	.000	.000
	8	F	16.186	211.405	212.339	93.647	118.206	101.904
		Sig.	.000	.000	.000	.000	.000	.000
15	1	F		299.128	349.334	248.197	310.133	272.229
		Sig.		.000	.000	.000	.000	.000
	2	F	299.128		483.404	128.276	115.911	130.951
		Sig.	.000		.000	.000	.000	.000
	3	F	349.334	483.404		425.416	485.050	474.817
		Sig.	.000	.000		.000	.000	.000
	4	F	248.197	128.276	425.416		11.705	4.218
		Sig.	.000	.000	.000		.000	.000
	5	F	310.133	115.911	485.050	11.705		7.693
		Sig.	.000	.000	.000	.000		.000
	6	F	272.229	130.951	474.817	4.218	7.693	
		Sig.	.000	.000	.000	.000	.000	
	7	F	298.317	419.923	19.001	340.250	377.266	371.363
		Sig.	.000	.000	.000	.000	.000	.000
	8	F	17.271	197.007	218.084	98.448	117.270	101.554
		Sig.	.000	.000	.000	.000	.000	.000
16	1	F		280.298	336.591	233.660	294.434	256.544
		Sig.		.000	.000	.000	.000	.000
	2	F	280.298		462.205	119.761	108.241	122.239
		Sig.	.000		.000	.000	.000	.000
	3	F	336.591	462.205		418.003	480.476	465.987
		Sig.	.000	.000		.000	.000	.000
	4	F	233.660	119.761	418.003		11.667	3.946
		Sig.	.000	.000	.000		.000	.000

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Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p]

Step	V2		1	2	3	4	5	6
16	5	F	294.434	108.241	480.476	11.667		7.846
		Sig.	.000	.000	.000	.000		.000
	6	F	256.544	122.239	465.987	3.946	7.846	
		Sig.	.000	.000	.000	.000	.000	
	7	F	284.181	399.511	17.800	329.250	367.732	359.114
		Sig.	.000	.000	.000	.000	.000	.000
	8	F	16.601	183.964	212.906	91.920	109.937	94.845
		Sig.	.000	.000	.000	.000	.000	.000

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Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p]

Step	V2		7	8
1	1	F	792.997	5.112
		Sig.	.000	.025
	2	F	759.771	13.424
		Sig.	.000	.000
	3	F	8.507	607.035
		Sig.	.004	.000
	4	F	789.553	12.193
		Sig.	.000	.001
	5	F	909.022	3.216
		Sig.	.000	.074
	6	F	849.437	9.257
		Sig.	.000	.003
	7	F		602.946
		Sig.		.000
	8	F	602.946	
		Sig.	.000	
2	1	F	505.747	14.629
		Sig.	.000	.000
	2	F	1413.481	454.805
		Sig.	.000	.000
	3	F	5.817	432.896
		Sig.	.003	.000
	4	F	1020.640	116.394
		Sig.	.000	.000
	5	F	1199.782	161.001
		Sig.	.000	.000
	6	F	1080.428	121.677
		Sig.	.000	.000
	7	F		428.048
		Sig.		.000
	8	F	428.048	
		Sig.	.000	
3	1	F	359.944	14.992
		Sig.	.000	.000
	2	F	1042.696	554.385
		Sig.	.000	.000
	3	F	11.598	374.237
		Sig.	.000	.000
	4	F	742.720	319.737
		Sig.	.000	.000
	5	F	856.887	342.669
		Sig.	.000	.000
	6	F	785.473	333.612
		Sig.	.000	.000
	7	F		318.102
		Sig.		.000
	8	F	318.102	
		Sig.	.000	
4	1	F	318.834	11.278
		Sig.	.000	.000

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Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p]

Step	V2		7	8
4	2	F	903.844	443.222
		Sig.	.000	.000
	3	F	8.678	325.660
		Sig.	.000	.000
	4	F	577.930	246.720
		Sig.	.000	.000
	5	F	658.615	267.486
		Sig.	.000	.000
	6	F	608.781	258.597
		Sig.	.000	.000
	7	F		272.853
		Sig.		.000
	8	F	272.853	
		Sig.	.000	
5	1	F	282.971	12.574
		Sig.	.000	.000
	2	F	722.777	372.597
		Sig.	.000	.000
	3	F	6.199	277.863
		Sig.	.000	.000
	4	F	461.014	216.228
		Sig.	.000	.000
	5	F	528.200	243.948
		Sig.	.000	.000
	6	F	485.218	223.912
		Sig.	.000	.000
	7	F		225.280
		Sig.		.000
	8	F	225.280	
		Sig.	.000	
6	1	F	359.865	16.628
		Sig.	.000	.000
	2	F	606.974	326.253
		Sig.	.000	.000
	3	F	36.659	236.365
		Sig.	.000	.000
	4	F	414.084	191.041
		Sig.	.000	.000
	5	F	472.039	213.422
		Sig.	.000	.000
	6	F	443.172	193.798
		Sig.	.000	.000
	7	F		236.175
		Sig.		.000
	8	F	236.175	
		Sig.	.000	
7	1	F	330.418	15.220
		Sig.	.000	.000
	2	F	668.749	364.593
		Sig.	.000	.000

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Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p]

Step	V2		7	8
7	3	F	31.293	213.046
		Sig.	.000	.000
	4	F	409.252	175.392
		Sig.	.000	.000
	5	F	475.586	202.619
		Sig.	.000	.000
	6	F	444.813	182.418
		Sig.	.000	.000
	7	F		211.027
		Sig.		.000
	8	F	211.027	
		Sig.	.000	
8	1	F	289.991	21.193
		Sig.	.000	.000
	2	F	586.818	319.336
		Sig.	.000	.000
	3	F	27.285	201.809
		Sig.	.000	.000
	4	F	371.147	153.183
		Sig.	.000	.000
	5	F	424.233	178.324
		Sig.	.000	.000
	6	F	401.084	159.629
		Sig.	.000	.000
	7	F		195.770
		Sig.		.000
	8	F	195.770	
		Sig.	.000	
9	1	F	257.124	20.908
		Sig.	.000	.000
	2	F	530.102	297.725
		Sig.	.000	.000
	3	F	24.779	178.609
		Sig.	.000	.000
	4	F	328.584	136.769
		Sig.	.000	.000
	5	F	375.819	157.854
		Sig.	.000	.000
	6	F	355.803	141.281
		Sig.	.000	.000
	7	F		173.642
		Sig.		.000
	8	F	173.642	
		Sig.	.000	
10	1	F	259.977	19.675
		Sig.	.000	.000
	2	F	515.953	275.117
		Sig.	.000	.000
	3	F	22.230	175.116
		Sig.	.000	.000

Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p]

Step	V2		7	8
10	4	F	330.036	123.413
		Sig.	.000	.000
	5	F	369.592	142.520
		Sig.	.000	.000
	6	F	354.067	128.054
		Sig.	.000	.000
	7	F		168.604
		Sig.		.000
	8	F	168.604	
		Sig.	.000	
11	1	F	285.970	19.286
		Sig.	.000	.000
	2	F	483.677	255.056
		Sig.	.000	.000
	3	F	20.335	208.701
		Sig.	.000	.000
	4	F	348.575	114.235
		Sig.	.000	.000
	5	F	378.317	133.538
		Sig.	.000	.000
	6	F	371.862	118.615
		Sig.	.000	.000
	7	F		197.855
		Sig.		.000
	8	F	197.855	
		Sig.	.000	
12	1	F	282.490	18.847
		Sig.	.000	.000
	2	F	442.793	235.279
		Sig.	.000	.000
	3	F	19.868	194.646
		Sig.	.000	.000
	4	F	321.181	107.875
		Sig.	.000	.000
	5	F	345.749	130.811
		Sig.	.000	.000
	6	F	341.186	113.885
		Sig.	.000	.000
	7	F		188.642
		Sig.		.000
	8	F	188.642	
		Sig.	.000	
13	1	F	267.234	17.507
		Sig.	.000	.000
	2	F	435.618	228.853
		Sig.	.000	.000
	3	F	18.340	184.637
		Sig.	.000	.000
	4	F	315.421	103.468
		Sig.	.000	.000

Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p]

Step	V2		7	8
13	5	F	344.217	127.497
		Sig.	.000	.000
	6	F	336.131	109.889
		Sig.	.000	.000
	7	F		176.892
		Sig.		.000
	8	F	176.892	
		Sig.	.000	
14	1	F	317.111	16.186
		Sig.	.000	.000
	2	F	448.000	211.405
		Sig.	.000	.000
	3	F	18.134	212.339
		Sig.	.000	.000
	4	F	365.987	95.647
		Sig.	.000	.000
	5	F	405.256	118.206
		Sig.	.000	.000
	6	F	398.636	101.904
		Sig.	.000	.000
	7	F		208.677
		Sig.		.000
	8	F	208.677	
		Sig.	.000	
15	1	F	298.317	17.271
		Sig.	.000	.000
	2	F	419.923	197.007
		Sig.	.000	.000
	3	F	19.001	218.064
		Sig.	.000	.000
	4	F	340.250	98.448
		Sig.	.000	.000
	5	F	377.266	117.270
		Sig.	.000	.000
	6	F	371.363	101.554
		Sig.	.000	.000
	7	F		201.473
		Sig.		.000
	8	F	201.473	
		Sig.	.000	
16	1	F	284.181	16.601
		Sig.	.000	.000
	2	F	399.511	183.964
		Sig.	.000	.000
	3	F	17.800	212.906
		Sig.	.000	.000
	4	F	329.250	91.920
		Sig.	.000	.000

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Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p]

Step	V2		7	8
16	5	F	387.732	109.937
		Sig.	.000	.000
	6	F	359.114	94.845
		Sig.	.000	.000
	7	F		194.280
		Sig.		.000
	8	F	194.280	
		Sig.	.000	

a. 1, 235 degrees of freedom for step 1.
b. 2, 234 degrees of freedom for step 2.
c. 3, 233 degrees of freedom for step 3.
d. 4, 232 degrees of freedom for step 4.
e. 5, 231 degrees of freedom for step 5.
f. 6, 230 degrees of freedom for step 6.
g. 7, 229 degrees of freedom for step 7.
h. 8, 228 degrees of freedom for step 8.
i. 9, 227 degrees of freedom for step 9.
j. 10, 226 degrees of freedom for step 10.
k. 11, 225 degrees of freedom for step 11.
l. 12, 224 degrees of freedom for step 12.
m. 13, 223 degrees of freedom for step 13.
n. 14, 222 degrees of freedom for step 14.
o. 15, 221 degrees of freedom for step 15.
p. 16, 220 degrees of freedom for step 16.

Summary of Canonical Discriminant Functions

Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	71.747[a]	67.6	67.6	.993
2	26.421[a]	24.9	92.6	.982
3	5.022[a]	4.7	97.3	.913
4	1.729[a]	1.6	98.9	.796
5	.589[a]	.6	99.5	.609
6	.401[a]	.4	99.9	.535
7	.152[a]	.1	100.0	.364

a. First 7 canonical discriminant functions were used in the analysis.

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Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 7	.000	2808.113	112	.000
2 through 7	.001	1622.106	90	.000
3 through 7	.024	860.506	70	.000
4 through 7	.143	447.566	52	.000
5 through 7	.390	216.665	36	.000
6 through 7	.620	110.124	22	.000
7	.868	32.638	10	.000

Standardized Canonical Discriminant Function Coefficients

	Function						
	1	2	3	4	5	6	7
Ti47	-.489	.153	1.941	.108	.289	.333	-.234
Mn55	-.153	-1.387	-.294	-1.382	.200	.368	-.445
Zn66	.873	.691	.520	-.270	-.638	-.356	.700
Ga69	-.243	-.689	.671	1.520	.371	-.267	-1.887
Rb85	-.937	.074	-1.000	-1.074	.428	1.023	1.189
Sr88	.774	1.013	-3.166	1.641	-1.302	-1.447	-.191
Y89	-1.237	-1.514	-1.372	1.102	-1.778	.129	.028
Nb93	2.140	.159	-.209	.304	-.140	-.584	.004
Ba137	.219	.034	1.040	-.923	1.464	1.340	.533
Fe57	-.153	.763	-.182	.757	-.766	.930	1.023
Ce140	-1.372	2.539	-2.030	-.843	.419	-.862	-1.859
Nd146	-.082	-2.047	.853	-1.327	-2.146	-.207	1.390
Sm147	.894	.170	.782	-.758	.831	-.429	-1.211
Eu153	.399	-1.716	.621	.875	.689	-.695	.328
Pr141	-1.247	-.556	1.943	.310	-.106	1.757	1.185
Gd158	1.390	2.827	.136	.267	3.859	-.549	.121

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Structure Matrix

	Function						
	1	2	3	4	5	6	7
Nb93	.332*	.245	.007	-.038	-.138	.142	-.220
Eu153	-.321*	.050	.137	.239	.123	-.279	.195
Sr88	-.254*	.123	-.113	.194	.201	-.132	.226
Tb159[a]	.224*	.200	.106	.056	-.108	-.113	.040
Dy163[a]	.223*	.193	.094	.052	-.118	-.124	.043
Ti47	-.210*	.179	.146	.090	.126	.082	-.107
Er166[a]	.209*	.176	.064	.049	-.149	-.132	.048
Y89	.206*	.155	.058	.070	-.178	-.102	.023
Tm169[a]	.203*	.160	.049	.053	-.140	-.147	.038
Ho165[a]	.198*	.187	.065	.048	-.132	-.117	.021
Yb173[a]	.184*	.152	.033	.040	-.156	-.128	.021
Lu175[a]	.159*	.135	.015	.060	-.157	-.132	.018
Ce140	-.263	.336*	.111	.042	-.071	.169	-.028
Pr141	-.118	.250*	.153	.051	.080	.180	.132
Sm147	.134	.209*	.164	.033	.130	.167	.026
Gd158	.201	.208*	.155	.071	.089	.136	.038
Ga69	.168	.122	.057	.349*	.154	.252	-.005
Ba137	-.239	.143	-.089	.123	.350*	.032	.283
Fe57	.023	.163	.183	.314	-.329	.486*	-.184
Mn55	.056	-.071	.054	.015	-.171	.371*	-.271
Zr90[a]	-.011	.202	.088	.004	-.048	-.231*	.125
Nd146	-.042	.215	.159	.044	-.114	-.225*	.134
Rb85	.168	.145	-.097	.096	-.017	.188*	.152
Zn66	.136	.121	.082	.184	-.273	.073	.286*

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions

Variables ordered by absolute size of correlation within function.

* Largest absolute correlation between each variable and any discriminant function

a. This variable not used in the analysis.

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Canonical Discriminant Function Coefficients

	Function						
	1	2	3	4	5	6	7
Ti47	-.011	.003	.043	.002	.006	.007	-.005
Mn55	-.005	-.045	-.009	-.045	.006	.012	.014
Zn66	.025	.020	.015	-.008	-.015	-.010	.020
Ga69	-.051	-.144	.140	.317	.077	-.056	-.394
Rb85	-.033	.003	-.035	-.038	.015	.036	.042
Sr88	.687	.899	-2.809	1.457	-1.155	-1.284	-.169
Y89	-.390	-.477	-.432	.347	-.560	.041	.009
Nb93	.312	.023	-.031	.044	-.020	-.082	.001
Ba137	.026	.004	.121	-.108	.171	.156	.062
Fe57	.000	.001	.000	.001	-.001	.001	.002
Ce140	-.227	.420	-.336	-.139	.069	-.143	-.307
Nd146	-.031	-.776	.248	-.503	-.813	-.078	.527
Sm147	1.337	.255	1.170	-1.133	-1.243	-.641	-1.812
Eu153	31.813	-136.974	49.547	69.831	53.004	-55.479	26.196
Pr141	-1.845	-.823	2.874	.458	-.156	2.599	1.753
Gd158	2.050	4.170	.201	.393	5.692	-.957	.178
(Constant)	.498	-10.602	-7.319	3.774	4.116	-9.053	5.353

Unstandardized coefficients

Functions at Group Centroids

	Function						
V2	1	2	3	4	5	6	7
1	4.389	-10.525	1.221	-1.032	.236	.515	.061
2	-14.894	4.457	10.113	-.129	-.105	-.562	-.133
3	20.325	5.407	.288	-2.171	.122	-1.136	-.031
4	-3.016	1.417	-.746	-.175	-1.112	.089	.475
5	-4.405	2.095	-.905	.264	1.146	-.026	.256
6	-3.591	1.052	-1.126	-.167	-.233	.134	-.597
7	21.964	6.824	2.379	3.407	-.061	1.527	-.051
8	3.013	-10.034	-.569	4.012	-.374	-1.892	-.085

Unstandardized canonical discriminant functions evaluated at group means

Classification Statistics

Classification Processing Summary

Processed		282
Excluded	Missing or out-of-range group codes	0
	At least one missing discriminating variable	5
Used in Output		277

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Prior Probabilities for Groups

V2	Prior	Cases Used in Analysis	
		Unweighted	Weighted
1	.125	33	33.000
2	.125	9	9.000
3	.125	17	17.000
4	.125	48	48.000
5	.125	55	55.000
6	.125	61	61.000
7	.125	10	10.000
8	.125	10	10.000
Total	1.000	243	243.000

Classification Function Coefficients

	V2							
	1	2	3	4	5	6	7	8
Ti47	.486	1.123	.311	.510	.537	.510	.421	.416
Mn55	.663	-.049	-.088	.126	.100	.170	-.401	.410
Zn66	.527	.480	1.242	.575	.511	.513	1.273	.489
Ga69	-1.523	-1.058	-4.994	-3.111	-2.748	-2.597	-3.344	-.030
Rb85	.067	.334	-.418	.352	.409	.354	-.665	-.127
Sr88	-48.333	-69.967	-19.843	-33.877	-35.530	-34.414	-16.267	-32.640
Y89	1.171	-1.845	-12.631	.250	-.575	.316	-12.671	4.240
Nb93	1.996	-3.814	7.461	.122	-.308	-.077	7.978	2.067
Ba137	2.820	3.130	3.017	2.077	2.329	2.105	3.091	1.538
Fe57	-.014	.005	-.003	.004	.003	.002	.008	-.010
Ce140	-.952	6.792	2.847	6.123	6.962	6.608	1.192	-.190
Nd146	.904	-8.112	-11.433	-7.700	-10.395	-8.775	-14.985	-1.605
Sm147	18.852	7.743	45.777	9.919	5.194	9.405	42.911	11.891
Eu153	1394.426	-731.499	-323.618	-554.141	-542.123	-522.645	-124.523	1643.149
Pr141	-.938	45.186	-51.088	-2.540	-1.818	-4.148	-39.754	-8.055
Gd158	-36.297	-12.152	63.089	-8.922	4.127	-6.926	71.410	-36.640
(Constant)	-314.612	-643.126	-616.826	-366.863	-369.138	-364.228	-700.302	-266.361

Fisher's linear discriminant functions

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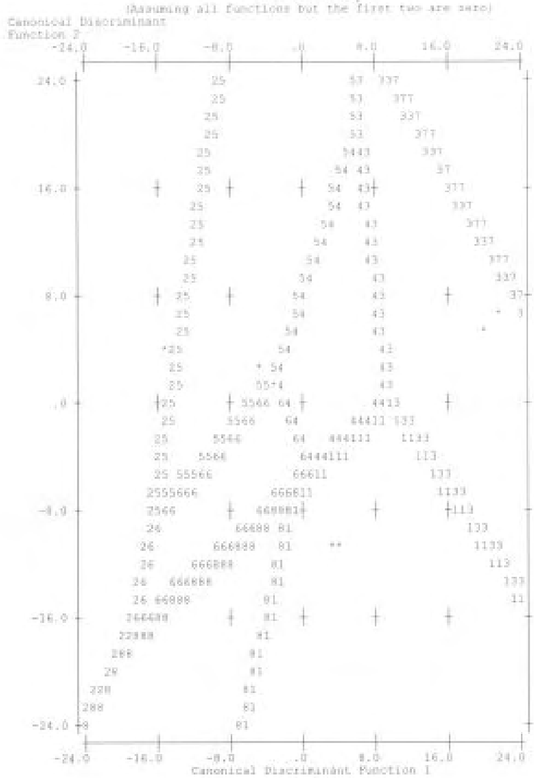
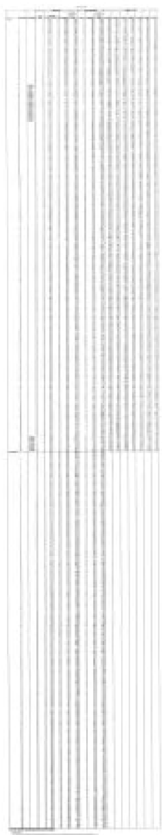
Territorial Map
(Assuming all functions but the first two are zero)

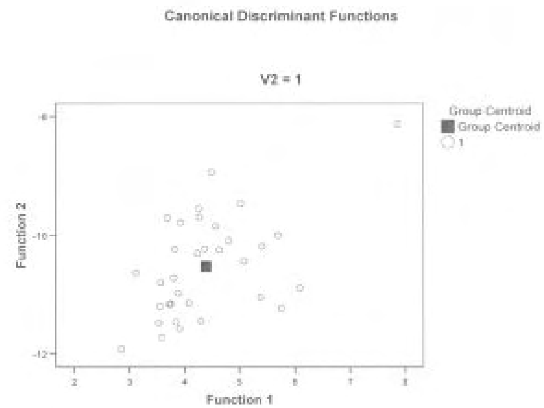


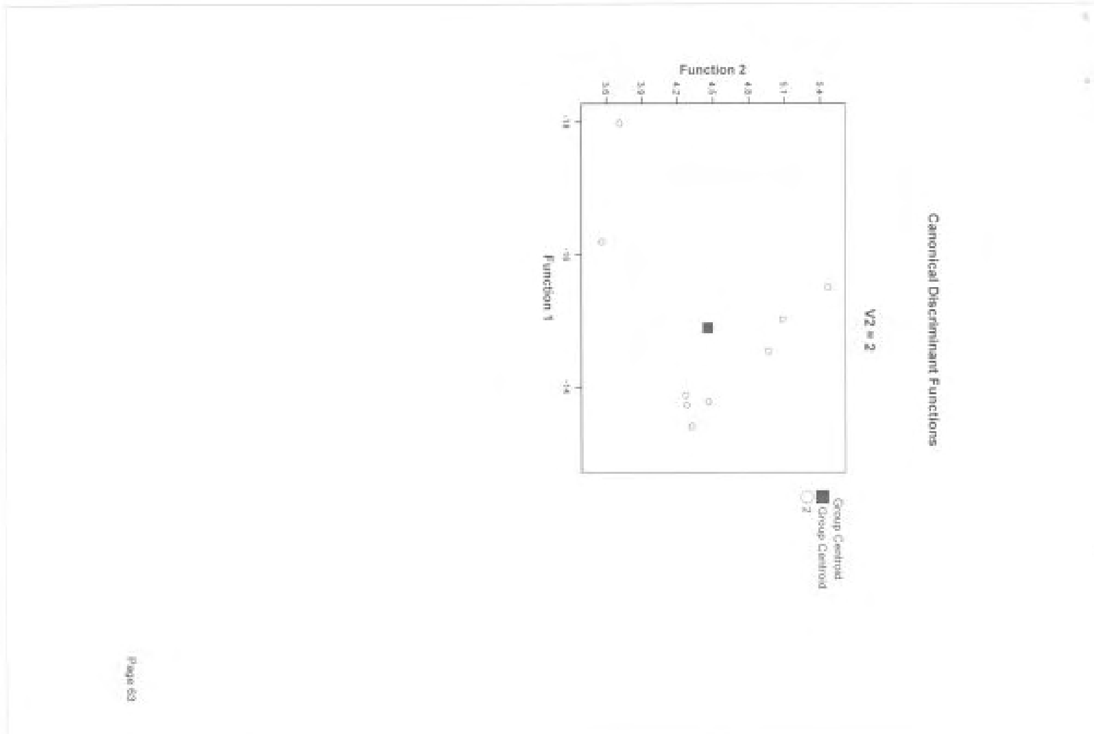
Symbols used in territorial map

Symbol	Group	Label
1	1	
2	2	
3	3	
4	4	
5	5	
6	6	
7	7	
8	8	
*		Indicates a group centroid



Separate-Groups Graphs




Canonical Discriminant Functions
V2 = 2
Function 1
Function 2
Group Centroid
Group Centroid
2
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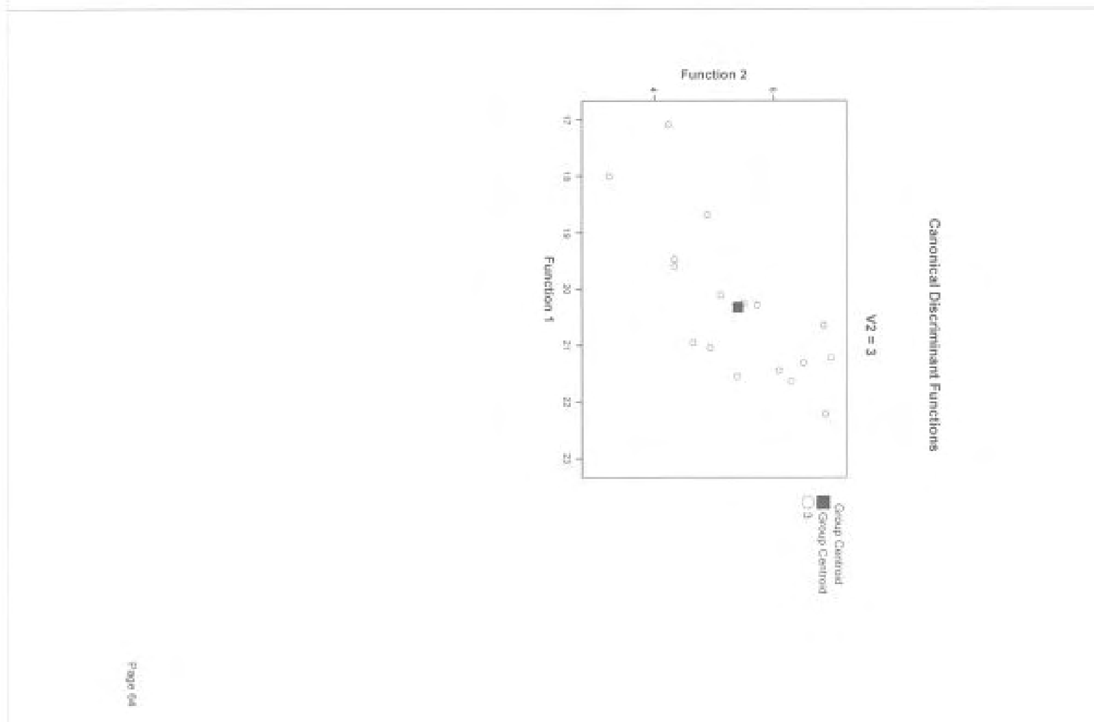
Canonical Discriminant Functions
V2 = 3
Function 1
Function 2
Group Centroid
Group Centroid
3
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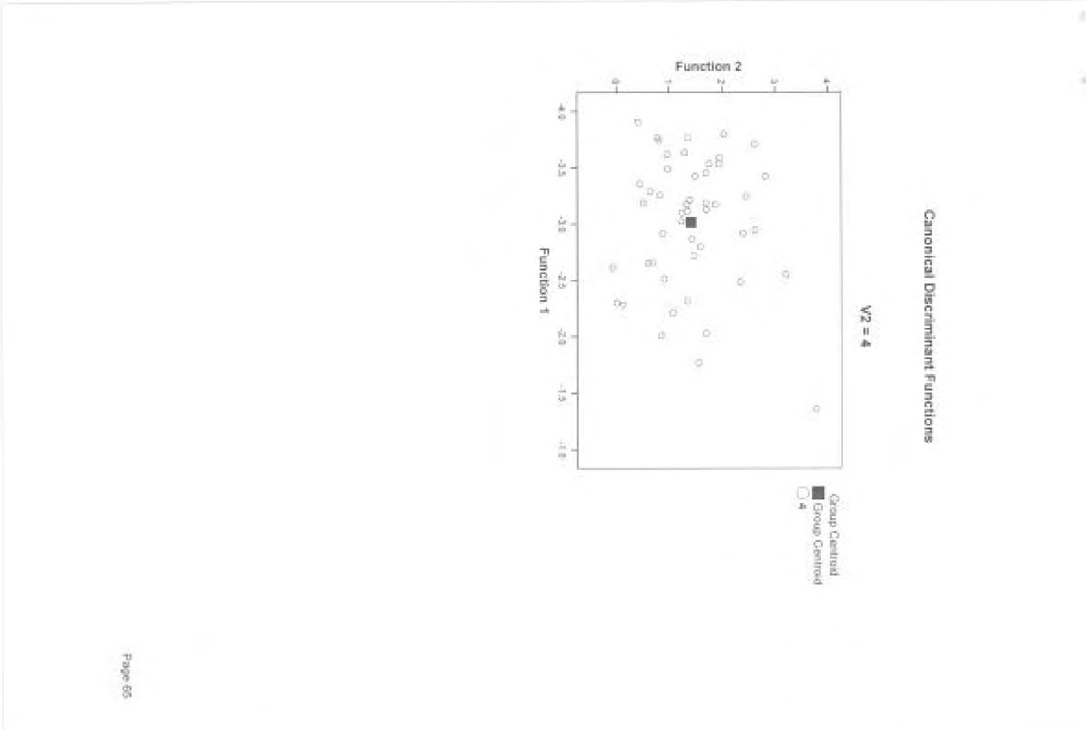
Canonical Discriminant Functions
V2 = 4
Function 1
Function 2
Group Centroid
Group Centroid
4
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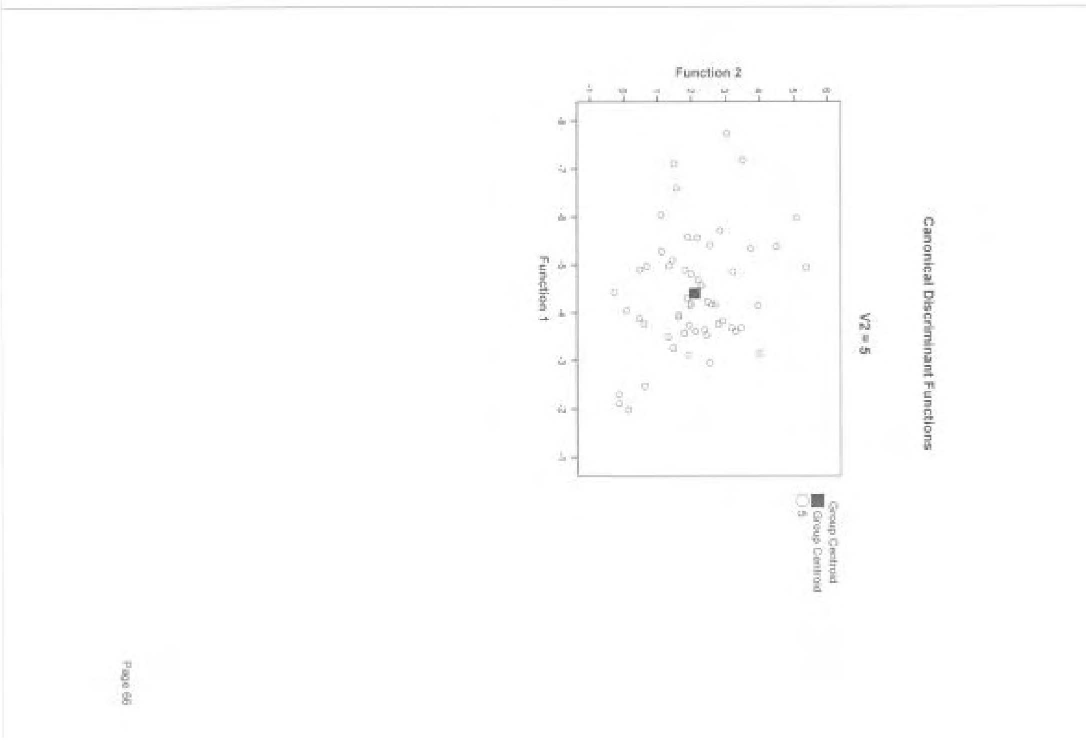
Canonical Discriminant Functions
V2 = 5
Function 1
Function 2
Group Centroid
Group Centroid
5
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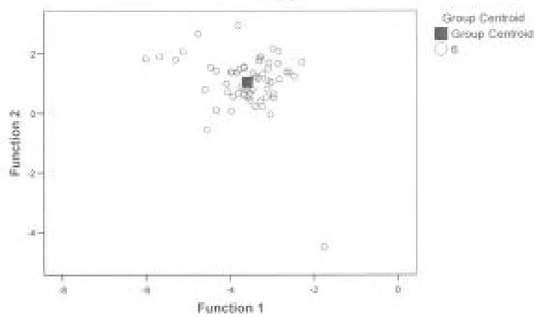
Canonical Discriminant Functions

V2 = 6



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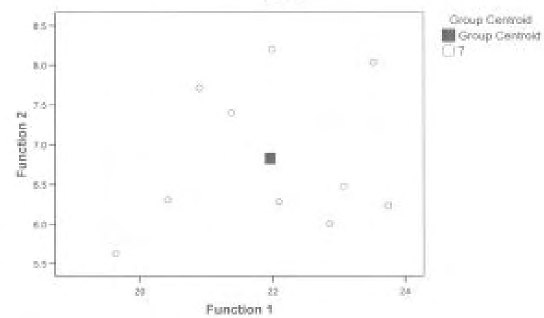
Canonical Discriminant Functions

V2 = 7



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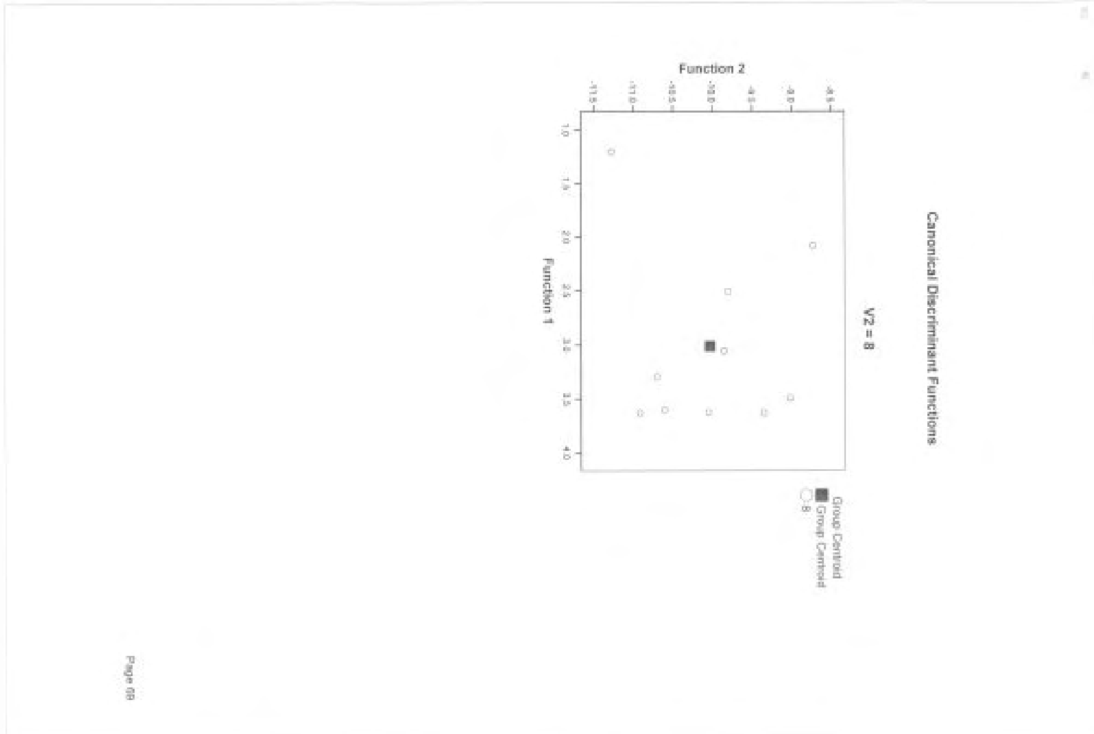
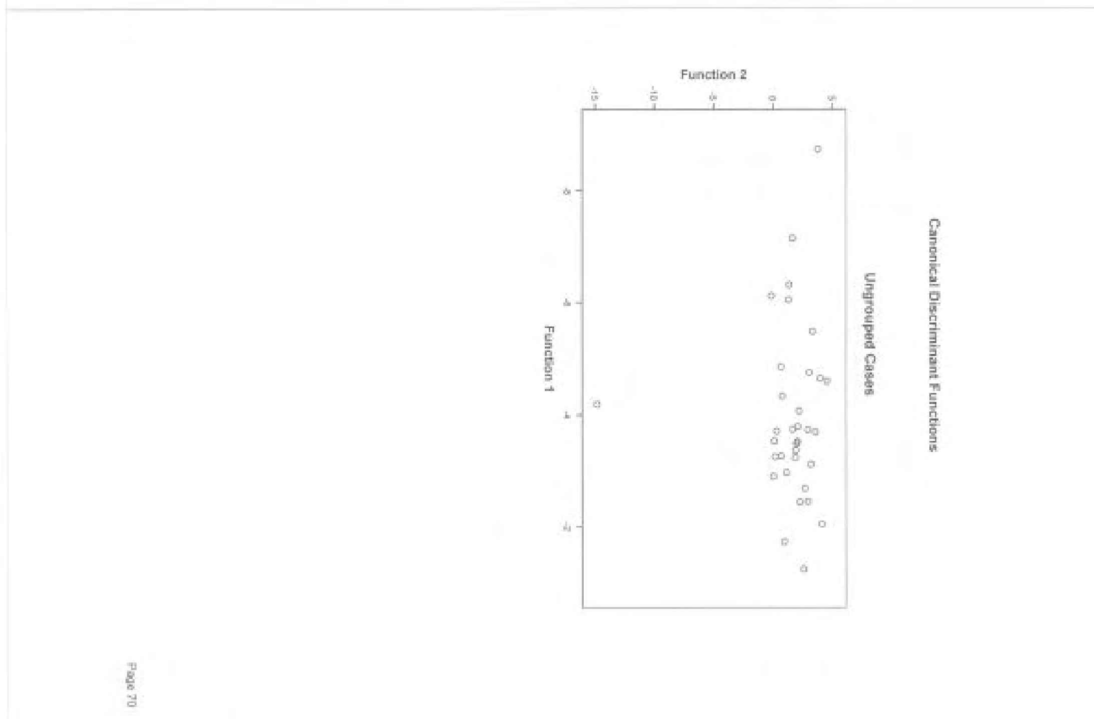

Canonical Discriminant Functions
V2 = 8
Function 1
Function 2
Group Centroid
Group Centroid
8


Canonical Discriminant Functions
Ungrouped Cases
Function 1
Function 2
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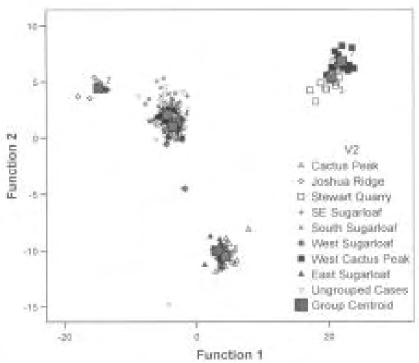
Canonical Discriminant Functions



Classification Results[a,c]

		V2	Predicted Group Membership 1	2	3	4	5
Original	Count	1	33	0	0	0	0
		2	0	9	0	0	0
		3	0	0	17	0	0
		4	0	0	0	38	2
		5	0	0	0	2	45
		6	0	0	0	11	3
		7	0	0	1	0	0
		8	0	0	0	0	0
		Ungrouped cases	1	0	0	21	7
	%	1	100.0	.0	.0	.0	.0
		2	.0	100.0	.0	.0	.0
		3	.0	.0	100.0	.0	.0
		4	.0	.0	.0	79.2	4.2
		5	.0	.0	.0	3.6	81.8
		6	.0	.0	.0	18.0	4.9
		7	.0	.0	10.0	.0	.0
		8	.0	.0	.0	.0	.0
		Ungrouped cases	2.9	.0	.0	61.8	20.6
Cross-validated[d]	Count	1	33	0	0	0	0
		2	0	9	0	0	0
		3	0	0	17	0	0
		4	0	0	0	34	4
		5	0	0	0	3	41
		6	1	0	0	12	6
		7	0	0	2	0	0
		8	0	0	0	0	0
	%	1	100.0	.0	.0	.0	.0
		2	.0	100.0	.0	.0	.0
		3	.0	.0	100.0	.0	.0
		4	.0	.0	.0	70.8	8.3
		5	.0	.0	.0	5.5	74.5
		6	1.6	.0	.0	19.7	9.8
		7	.0	.0	20.0	.0	.0
		8	.0	.0	.0	.0	.0

Classification Results[b,c]

		V2	Predicted Group Membership 6	7	8	Total
Original	Count	1	0	0	0	33
		2	0	0	0	9
		3	0	0	0	17
		4	8	0	0	48
		5	8	0	0	55
		6	47	0	0	61
		7	0	9	0	10
		8	0	0	10	10
		Ungrouped cases	5	0	0	34
	%	1	.0	.0	.0	100.0
		2	.0	.0	.0	100.0
		3	.0	.0	.0	100.0
		4	16.7	.0	.0	100.0
		5	14.5	.0	.0	100.0
		6	77.0	.0	.0	100.0
		7	.0	90.0	.0	100.0
		8	.0	.0	100.0	100.0
		Ungrouped cases	14.7	.0	.0	100.0
Cross-validated[a]	Count	1	0	0	0	33
		2	0	0	0	9
		3	0	0	0	17
		4	10	0	0	48
		5	11	0	0	55
		6	42	0	0	61
		7	0	8	0	10
		8	0	0	10	10
	%	1	.0	.0	.0	100.0
		2	.0	.0	.0	100.0
		3	.0	.0	.0	100.0
		4	20.8	.0	.0	100.0
		5	20.0	.0	.0	100.0
		6	68.9	.0	.0	100.0
		7	.0	80.0	.0	100.0
		8	.0	.0	100.0	100.0

a. Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case.

b. 85.6% of original grouped cases correctly classified.

c. 79.8% of cross-validated grouped cases correctly classified.

Appendix F Cont.: Output of Statistical Analysis using SPSS software of Laser Ablation data from Coso Obsidian, with subsource chemical group used as grouping number.

Discriminant

[DataSet1] C:\Documents and Settings\student\Desktop\AnnesStuff\ALL_PPM_10012007.sav

Analysis Case Processing Summary

Unweighted Cases		N	Percent
Valid		243	86.2
Excluded	Missing or out-of-range group codes	34	12.1
	At least one missing discriminating variable	0	.0
	Both missing or out-of-range group codes and at least one missing discriminating variable	5	1.8
	Total	39	13.8
Total		282	100.0

Group Statistics

V3		Mean	Std. Deviation	Valid N (listwise)	
				Unweighted	Weighted
1.00	Ti47	610.44589	38.315560	43	43.000
	Mn55	564.20742	31.774453	43	43.000
	Zn66	273.90385	30.344955	43	43.000
	Ga69	57.05191	3.991765	43	43.000
	Rb85	271.34381	17.767512	43	43.000
	Sr88	4.93192	1.192418	43	43.000
	Y89	32.03167	2.824679	43	43.000
	Zr90	280.03996	27.635842	43	43.000
	Nb93	103.98875	5.837787	43	43.000
	Ba137	19.52994	10.756871	43	43.000
	Fe57	10353.842	575.799696	43	43.000
	Ce140	68.97259	5.460005	43	43.000
	Nd146	25.19381	2.289103	43	43.000
	Sm147	6.78167	.546801	43	43.000
	Eu153	.08675	.013636	43	43.000
	Tb159	1.22883	.108184	43	43.000
	Dy163	7.98025	.687286	43	43.000
	Er166	4.62387	.465420	43	43.000

Group Statistics

V3		Mean	Std. Deviation	Valid N (listwise)	
				Unweighted	Weighted
1.00	Tm169	.71501	.078146	43	43.000
	Yb172	4.88344	.566229	43	43.000
	Pr141	6.72970	.581746	43	43.000
	Ho165	1.58010	.148476	43	43.000
	Lu175	.64170	.089477	43	43.000
	Gd158	6.80392	.586614	43	43.000
2.00	Ti47	967.53880	61.822297	9	9.000
	Mn55	510.30146	30.276046	9	9.000
	Zn66	270.88663	30.217306	9	9.000
	Ga69	52.08943	3.206288	9	9.000
	Rb85	212.44388	10.282977	9	9.000
	Sr88	11.16808	.917501	9	9.000
	Y89	28.85912	3.307380	9	9.000
	Zr90	395.86468	39.804730	9	9.000
	Nb93	87.16729	4.839233	9	9.000
	Ba137	68.43076	5.426908	9	9.000
	Fe57	12667.473	685.234190	9	9.000
	Ce140	136.17028	10.315821	9	9.000
	Nd146	39.94449	4.201437	9	9.000
	Sm147	8.25227	.906957	9	9.000
	Eu153	.16840	.021209	9	9.000
	Tb159	1.20767	.130798	9	9.000
	Dy163	7.59418	.837076	9	9.000
	Er166	4.17398	.475617	9	9.000
	Tm169	.63653	.069625	9	9.000
	Yb172	4.27803	.449156	9	9.000
	Pr141	11.76836	1.160435	9	9.000
	Ho165	1.47701	.174536	9	9.000
	Lu175	.56301	.064883	9	9.000
	Gd158	7.30553	.789510	9	9.000

Group Statistics

V3		Mean	Std. Deviation	Valid N (listwise) Unweighted	Valid N (listwise) Weighted
3.00	Ti47	582.92823	48.341345	27	27.000
	Mn55	557.66013	48.023570	27	27.000
	Zn66	424.00248	74.642733	27	27.000
	Ga69	79.83433	12.283918	27	27.000
	Rb85	416.35658	49.405223	27	27.000
	Sr88	2.27846	.302804	27	27.000
	Y89	51.13401	5.789990	27	27.000
	Zr90	360.88360	64.982654	27	27.000
	Nb93	168.90353	15.598913	27	27.000
	Ba137	4.30007	.822810	27	27.000
	Fe57	12365.688	1827.012723	27	27.000
	Ce140	75.65785	5.765846	27	27.000
	Nd146	32.74958	3.461832	27	27.000
	Sm147	10.61194	1.106733	27	27.000
	Eu153	.02909	.005617	27	27.000
	Tb159	2.08224	.237256	27	27.000
	Dy163	13.42007	1.482549	27	27.000
	Er166	7.46100	.811369	27	27.000
	Tm169	1.12184	.122189	27	27.000
	Yb172	7.47407	.823157	27	27.000
	Pr141	8.17183	.829090	27	27.000
	Ho165	2.61253	.292753	27	27.000
	Lu175	.98307	.108091	27	27.000
	Gd158	11.41013	1.251573	27	27.000

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Group Statistics

V3		Mean	Std. Deviation	Valid N (listwise) Unweighted	Valid N (listwise) Weighted
4.00	Ti47	767.69712	47.341638	164	164.000
	Mn55	523.60997	29.585829	164	164.000
	Zn66	282.85010	30.944795	164	164.000
	Ga69	57.22021	3.911064	164	164.000
	Rb85	288.20345	27.257408	164	164.000
	Sr88	8.94620	1.355377	164	164.000
	Y89	32.48010	2.728202	164	164.000
	Zr90	341.08286	26.868064	164	164.000
	Nb93	105.19249	5.067299	164	164.000
	Ba137	50.60909	10.038452	164	164.000
	Fe57	11354.927	531.089307	164	164.000
	Ce140	104.26726	6.181758	164	164.000
	Nd146	32.04254	2.504569	164	164.000
	Sm147	7.55843	.592260	164	164.000
	Eu153	.12125	.014360	164	164.000
	Tb159	1.27505	.107907	164	164.000
	Dy163	8.24924	.701062	164	164.000
	Er166	4.71189	.403353	164	164.000
	Tm169	.72950	.065419	164	164.000
	Yb172	4.97276	.440762	164	164.000
	Pr141	9.16653	.652291	164	164.000
	Ho165	1.61844	.147261	164	164.000
	Lu175	.64962	.060249	164	164.000
	Gd158	7.21018	.570089	164	164.000

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Group Statistics

V3		Mean	Std. Deviation	Valid N (listwise)	
				Unweighted	Weighted
Total	Ti47	726.74243	100.725351	243	243.000
	Mn55	534.08432	36.898675	243	243.000
	Zn66	296.50752	59.066605	243	243.000
	Ga69	59.51308	9.076452	243	243.000
	Rb85	296.65338	53.343798	243	243.000
	Sr88	7.57729	2.766379	243	243.000
	Y89	34.33930	6.799766	243	243.000
	Zr90	334.51007	43.572522	243	243.000
	Nb93	111.21393	21.898093	243	243.000
	Ba137	40.75908	20.354672	243	243.000
	Fe57	11338.697	988.698847	243	243.000
	Ce140	96.02449	17.896807	243	243.000
	Nd146	31.20185	4.124111	243	243.000
	Sm147	7.78595	1.249330	243	243.000
	Eu153	.10739	.036378	243	243.000
	Tb159	1.35368	.288936	243	243.000
	Dy163	8.75192	1.852169	243	243.000
	Er166	4.98185	1.003767	243	243.000
	Tm169	.76708	.147719	243	243.000
	Yb172	5.20561	.964178	243	243.000
	Pr141	8.72109	1.298686	243	243.000
	Ho165	1.71687	.360804	243	243.000
	Lu175	.68206	.129875	243	243.000
	Gd158	7.60848	1.518534	243	243.000

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Tests of Equality of Group Means

	Wilks' Lambda	F	df1	df2	Sig.
Ti47	.211	297.711	3	239	.000
Mn55	.766	24.341	3	239	.000
Zn66	.411	114.210	3	239	.000
Ga69	.360	141.909	3	239	.000
Rb85	.289	196.471	3	239	.000
Sr88	.199	320.673	3	239	.000
Y89	.224	275.838	3	239	.000
Zr90	.592	54.840	3	239	.000
Nb93	.105	682.472	3	239	.000
Ba137	.215	291.186	3	239	.000
Fe57	.636	45.603	3	239	.000
Ce140	.119	591.780	3	239	.000
Nd146	.412	113.748	3	239	.000
Sm147	.287	198.251	3	239	.000
Eu153	.143	476.906	3	239	.000
Tb159	.197	325.556	3	239	.000
Dy163	.196	326.828	3	239	.000
Er166	.224	276.472	3	239	.000
Tm169	.262	224.954	3	239	.000
Yb172	.286	198.797	3	239	.000
Pr141	.276	209.181	3	239	.000
Ho165	.220	282.353	3	239	.000
Lu175	.310	177.325	3	239	.000
Gd158	.203	313.265	3	239	.000

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Pooled Within-Groups Matrices[a]

		Ti47	Mn55	Zn66	Ga69	Rb85	Sr88	Y89	Zr90	Nb93	Ba137
Covariance	Ti47	2168.682	841.880	-268.452	42.579	225.782	43.118	61.374	855.092	148.002	288.385
	Mn55	841.880	1055.972	267.547	75.933	177.594	11.588	50.535	322.720	124.751	57.323
	Zn66	-268.452	267.547	1451.567	158.339	624.303	3.307	30.452	119.262	19.612	-1.833
	Ga69	42.579	75.933	158.339	29.992	125.917	1.045	9.613	53.520	19.393	1.900
	Rb85	225.782	177.594	624.303	125.917	831.259	3.858	53.826	362.838	125.090	-2.137
	Sr88	43.118	11.588	3.307	1.045	3.858	1.541	1.087	23.101	.189	11.065
	Y89	61.374	50.535	30.452	9.613	53.826	1.087	10.491	78.325	18.022	3.581
	Zr90	855.092	322.720	119.262	53.520	362.838	23.101	78.325	1138.608	114.609	138.185
	Nb93	148.002	124.751	19.612	19.393	125.090	.189	18.022	114.609	50.796	-7.110
	Ba137	288.385	57.323	-1.833	1.900	-2.137	11.065	3.581	138.185	-7.110	90.120
	Fe57	17452.256	20103.465	10599.945	2732.087	5878.963	217.541	1175.775	6419.718	2819.224	984.887
	Ce140	223.826	94.049	25.632	11.190	52.352	5.836	12.832	157.420	20.796	37.653
	Nd146	76.086	37.847	23.110	6.495	35.175	2.056	7.309	74.502	11.132	12.336
	Sm147	16.450	10.670	6.077	1.872	10.512	.373	2.030	17.708	3.378	1.912
	Eu153	.469	.129	.059	.017	.054	.016	.017	.292	.009	.107
	Tb159	2.614	2.035	1.355	.403	2.240	.051	.410	3.236	.715	.218
	Dy163	16.616	13.024	8.542	2.518	14.177	.324	2.630	20.617	4.586	1.328
	Er166	8.779	6.891	4.963	1.408	7.922	.173	1.522	11.526	2.529	.650
	Tm169	1.357	1.074	.791	.220	1.242	.028	.241	1.788	.393	.103
	Yb172	9.262	7.277	5.198	1.469	8.431	.188	1.620	11.931	2.682	.688
	Pr141	21.189	9.814	5.735	1.599	8.898	.581	1.776	18.939	2.725	3.543
	Ho165	3.283	2.683	1.783	.512	2.820	.066	.539	4.181	.912	.265
	Lu175	1.206	.950	.778	.209	1.151	.026	.222	1.570	.351	.099
	Gd158	15.026	11.145	7.090	2.117	11.189	.306	2.166	17.690	3.648	1.416

Pooled Within-Groups Matrices[a]

		Ti47	Mn55	Zn66	Ga69	Rb85	Sr88	Y89	Zr90	Nb93	Ba137
Correlation	Ti47	1.000	.556	-.151	.167	.168	.746	.407	.544	.446	.652
	Mn55	.556	1.000	.216	.427	.190	.287	.480	.294	.539	.186
	Zn66	-.151	.216	1.000	.759	.568	.070	.247	.093	.072	-.005
	Ga69	.167	.427	.759	1.000	.797	.154	.542	.290	.497	.037
	Rb85	.168	.190	.568	.797	1.000	.108	.576	.373	.609	-.008
	Sr88	.746	.287	.070	.154	.108	1.000	.270	.552	.021	.939
	Y89	.407	.480	.247	.542	.576	.270	1.000	.717	.781	.116
	Zr90	.544	.294	.093	.290	.373	.552	.717	1.000	.477	.431
	Nb93	.446	.539	.072	.497	.609	.021	.781	.477	1.000	-.105
	Ba137	.652	.186	-.005	.037	-.008	.939	.116	.431	-.105	1.000
	Fe57	.472	.780	.351	.629	.257	.221	.458	.240	.499	.131
	Ce140	.775	.467	.108	.329	.293	.758	.639	.752	.471	.639
	Nd146	.613	.437	.228	.445	.458	.622	.847	.829	.587	.488
	Sm147	.525	.488	.237	.508	.542	.447	.931	.780	.704	.299
	Eu153	.728	.287	.112	.223	.136	.913	.382	.625	.093	.815
	Tb159	.436	.486	.276	.571	.603	.321	.982	.744	.778	.178
	Dy163	.432	.486	.272	.557	.596	.317	.984	.741	.760	.170
	Er166	.396	.444	.273	.538	.575	.292	.984	.715	.743	.143
	Tm169	.383	.435	.273	.527	.567	.293	.978	.697	.726	.143
	Yb172	.383	.432	.263	.517	.564	.291	.964	.681	.725	.140
	Pr141	.684	.441	.220	.426	.450	.683	.800	.819	.558	.545
	Ho165	.414	.485	.275	.549	.574	.311	.977	.728	.752	.164
	Lu175	.356	.402	.281	.525	.549	.290	.944	.639	.677	.144
	Gd158	.469	.498	.270	.562	.564	.358	.972	.762	.744	.217

Pooled Within-Groups Matrices[a]

		Fe57	Ce140	Nd146	Sm147	Eu153	Tb159	Dy163	Er166	Tm169	Yb172
Covariance	Ti47	17452.296	223.626	76.086	16.450	.469	2.614	16.616	8.779	1.357	9.262
	Mn55	20103.465	94.049	37.847	10.670	.129	2.035	13.024	6.891	1.074	7.277
	Zn66	10599.945	25.632	23.110	6.077	.059	1.355	8.542	4.963	.791	5.198
	Ga69	2732.087	11.190	6.495	1.872	.017	.403	2.518	1.408	.220	1.469
	Rb85	5878.963	52.352	35.175	10.512	.054	2.240	14.177	7.922	1.242	8.431
	Sr88	217.541	5.836	2.056	.373	.016	.051	.324	.173	.028	.188
	Y89	1175.775	12.632	7.309	2.030	.017	.410	2.630	1.522	.241	1.620
	Zr90	6419.718	157.420	74.502	17.708	.292	3.236	20.617	11.526	1.788	11.931
	Nb93	2819.224	20.796	11.132	3.378	.009	.715	4.586	2.529	.393	2.682
	Ba137	984.887	37.653	12.336	1.912	.107	.218	1.328	.650	.103	.688
	Fe57	629471.70	2071.551	847.662	239.540	3.233	46.525	290.335	159.078	23.759	156.633
	Ce140	2071.551	38.480	14.873	3.203	.073	.545	3.474	1.919	.301	2.056
	Nd146	847.662	14.873	7.094	1.665	.027	.303	1.934	1.078	.169	1.138
	Sm147	239.540	3.203	1.665	.453	.005	.082	.526	.295	.046	.311
	Eu153	3.233	.073	.027	.005	.000	.001	.005	.003	.000	.003
	Tb159	46.525	.545	.303	.082	.001	.017	.106	.060	.009	.063
	Dy163	290.335	3.474	1.934	.526	.005	.106	.681	.388	.061	.411
	Er166	159.078	1.919	1.078	.295	.003	.060	.388	.228	.036	.244
	Tm169	23.759	.301	.169	.046	.000	.009	.061	.036	.006	.039
	Yb172	156.633	2.056	1.138	.311	.003	.063	.411	.244	.039	.269
	Pr141	211.182	3.959	1.770	.414	.007	.074	.473	.263	.041	.280
	Ho165	59.814	.705	.390	.107	.001	.021	.138	.080	.013	.086
	Lu175	21.790	.279	.154	.042	.000	.009	.056	.034	.006	.037
	Gd158	264.924	3.028	1.653	.445	.005	.088	.559	.316	.050	.331

Pooled Within-Groups Matrices[a]

		Fe57	Ce140	Nd146	Sm147	Eu153	Tb159	Dy163	Er166	Tm169	Yb172
Correlation	Ti47	.472	.775	.613	.525	.728	.436	.432	.395	.383	.380
	Mn55	.780	.467	.437	.488	.287	.486	.486	.444	.435	.432
	Zn66	.351	.108	.228	.237	.112	.276	.272	.273	.273	.263
	Ga69	.629	.329	.445	.508	.223	.571	.557	.538	.527	.517
	Rb85	.257	.293	.458	.542	.136	.603	.596	.575	.567	.564
	Sr88	.221	.758	.622	.447	.913	.321	.317	.292	.293	.291
	Y89	.458	.639	.847	.931	.382	.982	.984	.984	.978	.964
	Zr90	.240	.752	.629	.780	.625	.744	.741	.715	.697	.681
	Nb93	.499	.471	.587	.704	.093	.778	.780	.743	.726	.725
	Ba137	.131	.639	.488	.299	.815	.178	.170	.143	.143	.140
	Fe57	1.000	.421	.401	.449	.294	.455	.444	.420	.394	.380
	Ce140	.421	1.000	.900	.767	.848	.681	.679	.648	.638	.639
	Nd146	.401	.900	1.000	.929	.734	.883	.880	.848	.837	.823
	Sm147	.449	.767	.929	1.000	.556	.950	.946	.919	.908	.891
	Eu153	.294	.848	.734	.556	1.000	.430	.425	.406	.402	.395
	Tb159	.455	.681	.883	.950	.430	1.000	.996	.976	.965	.946
	Dy163	.444	.679	.880	.946	.425	.996	1.000	.984	.974	.959
	Er166	.420	.648	.848	.919	.406	.976	.984	1.000	.992	.984
	Tm169	.394	.638	.837	.908	.402	.965	.974	.992	1.000	.992
	Yb172	.380	.639	.823	.891	.395	.946	.959	.984	.992	1.000
	Pr141	.388	.931	.970	.899	.778	.841	.837	.803	.794	.787
	Ho165	.443	.668	.859	.930	.416	.979	.983	.983	.979	.968
	Lu175	.377	.618	.796	.862	.398	.917	.931	.969	.983	.989
	Gd158	.485	.709	.902	.960	.481	.989	.985	.962	.951	.927

Pooled Within-Groups Matrices[a]

		Pr141	Ho165	Lu175	Gd158
Covariance	Ti47	21.189	3.283	1.206	15.026
	Mn55	8.814	2.683	.950	11.145
	Zn66	5.735	1.783	.778	7.090
	Ga69	1.599	.512	.209	2.117
	Rb85	8.898	2.820	1.151	11.189
	Sr88	.581	.068	.026	.306
	Y89	1.776	.539	.222	2.166
	Zr90	18.939	4.181	1.570	17.690
	Nb93	2.725	.912	.351	3.648
	Ba137	3.543	.265	.099	1.416
	Fe57	211.182	59.814	21.790	264.924
	Ce140	3.959	.705	.279	3.028
	Nd146	1.770	.390	.154	1.653
	Sm147	.414	.107	.042	.445
	Eu153	.007	.001	.000	.005
	Tb159	.074	.021	.009	.088
	Dy163	.473	.138	.056	.559
	Er166	.263	.080	.034	.316
	Tm169	.041	.013	.005	.050
	Yb172	.280	.086	.037	.331
	Pr141	.470	.096	.038	.405
	Ho165	.096	.029	.012	.113
	Lu175	.038	.012	.005	.045
	Gd158	.405	.113	.045	.473

Pooled Within-Groups Matrices[a]

		Pr141	Ho165	Lu175	Gd158
Correlation	Ti47	.664	.414	.356	.469
	Mn55	.441	.485	.402	.498
	Zn66	.220	.275	.281	.270
	Ga69	.426	.549	.525	.562
	Rb85	.450	.574	.549	.564
	Sr88	.683	.311	.290	.358
	Y89	.800	.977	.944	.972
	Zr90	.819	.728	.639	.762
	Nb93	.558	.752	.677	.744
	Ba137	.545	.164	.144	.217
	Fe57	.388	.443	.377	.486
	Ce140	.931	.668	.618	.709
	Nd146	.970	.859	.796	.902
	Sm147	.899	.930	.862	.960
	Eu153	.778	.416	.398	.481
	Tb159	.841	.979	.917	.989
	Dy163	.837	.983	.931	.985
	Er166	.803	.983	.969	.962
	Tm169	.794	.979	.983	.951
	Yb172	.787	.968	.989	.927
	Pr141	1.000	.818	.759	.860
	Ho165	.818	1.000	.950	.967
	Lu175	.759	.950	1.000	.900
	Gd158	.860	.967	.900	1.000

a. The covariance matrix has 239 degrees of freedom.

Covariance Matrices[a]

V3		Ti47	Mn55	Zn66	Ga69	Rb85	Sr88	Y89	Zr90	Nb93	Ba137
1.00	Ti47	1468.082	655.864	-244.057	5.001	119.141	25.660	76.804	821.464	158.757	163.083
	Mn55	655.864	1009.616	51.352	-1.455	4.187	-.639	45.508	256.259	132.515	16.216
	Zn66	-244.057	51.352	920.816	103.227	274.222	3.320	6.249	-.484	-32.778	-13.660
	Ga69	5.001	-1.455	103.227	15.934	45.345	1.502	2.162	18.872	-2.852	2.126
	Rb85	119.141	4.187	274.222	45.345	315.684	-.026	9.985	106.983	36.896	-24.606
	Sr88	25.660	-.639	3.320	1.502	-.026	1.422	1.667	20.630	-.231	10.804
	Y89	76.804	45.508	6.249	2.162	9.985	1.667	7.979	53.757	9.704	10.636
	Zr90	821.464	256.259	-.484	18.872	106.983	20.630	53.757	763.740	84.629	114.491
	Nb93	158.757	132.515	-32.778	-2.852	36.896	-.231	9.704	84.629	34.080	-1.078
	Ba137	163.083	16.216	-13.660	2.126	-24.606	10.804	10.636	114.491	-1.078	115.710
	Fe57	11220.861	13710.967	7745.341	1118.813	1918.190	220.383	783.256	5692.893	1200.750	1125.814
	Ce140	168.193	88.291	23.068	7.437	20.530	4.278	12.638	126.870	17.104	23.128
	Nd146	70.598	33.246	5.695	2.392	10.465	1.749	5.706	56.966	8.064	10.652
	Sm147	16.999	9.478	.519	.394	2.467	.337	1.408	12.544	2.217	2.059
	Eu153	.331	.015	.067	.025	.035	.014	.024	.283	.009	.072
	Tb159	3.063	1.804	.179	.072	.419	.065	.287	2.359	.408	.459
	Dy163	19.554	11.536	1.365	.479	2.698	.407	1.890	14.545	2.616	2.787
	Er166	11.297	5.979	2.029	.482	1.696	.285	1.282	7.721	1.286	1.798
	Tm169	1.711	.870	.388	.086	.267	.045	.211	1.113	.192	.288
	Yb172	11.671	6.642	2.809	.643	1.724	.325	1.460	6.916	1.206	2.078
	Pr141	18.315	9.197	1.255	.588	2.355	.437	1.438	14.484	2.050	2.543
	Ho165	3.696	2.381	.716	.146	.528	.092	.407	2.576	.455	.655
	Lu175	1.501	.826	.597	.118	.281	.049	.217	.822	.131	.309
	Gd158	16.838	10.145	1.654	.453	2.678	.335	1.566	13.312	2.330	2.129

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Covariance Matrices[a]

V3		Ti47	Mn55	Zn66	Ga69	Rb85	Sr88	Y89	Zr90	Nb93	Ba137
2.00	Ti47	3821.996	1122.405	-984.731	-92.016	-168.869	51.319	171.835	2233.026	211.620	285.590
	Mn55	1122.405	916.639	162.396	1.385	-125.510	19.058	81.389	880.298	123.192	110.286
	Zn66	-984.731	162.396	913.086	76.924	107.539	-10.543	-6.679	-246.973	12.980	-53.566
	Ga69	-92.016	1.385	76.924	10.280	24.340	-1.414	-.096	-14.406	1.541	-7.073
	Rb85	-168.869	-125.510	107.539	24.340	105.740	-3.622	-1.796	-15.413	-1.612	-17.854
	Sr88	51.319	19.058	-10.543	-1.414	-3.622	.842	2.582	32.510	3.627	4.910
	Y89	171.835	81.389	-6.679	-.096	-1.796	2.582	10.939	129.360	15.385	15.459
	Zr90	2233.026	880.298	-246.973	-14.406	-15.413	32.510	129.360	1584.416	177.825	191.979
	Nb93	211.620	123.192	12.980	1.541	-1.612	3.627	15.385	177.825	23.418	22.402
	Ba137	285.590	110.286	-53.566	-7.073	-17.854	4.910	15.459	191.979	22.402	29.451
	Fe57	30554.972	19495.533	2247.785	-67.201	-2180.342	453.857	1944.613	22027.841	2729.556	2511.276
	Ce140	570.301	250.683	-47.043	-6.395	-20.247	8.899	33.158	400.708	46.569	52.243
	Nd146	230.867	102.767	-18.591	-2.357	-7.867	3.590	13.605	163.475	19.087	21.147
	Sm147	47.261	22.209	-2.118	-.175	-.969	.717	2.959	35.065	4.136	4.255
	Eu153	1.255	.455	-.222	-.028	-.067	.019	.063	.788	.084	.108
	Tb159	6.759	3.083	-.285	-.010	-.043	.104	.431	5.113	.608	.626
	Dy163	42.898	20.316	-1.697	-.090	-.577	.672	2.752	32.549	3.931	4.063
	Er166	24.436	11.471	-1.016	-.034	-.264	.375	1.562	18.444	2.210	2.264
	Tm169	3.587	1.684	-.170	-.008	-.052	.055	.229	2.703	.323	.334
	Yb172	23.560	10.725	-1.360	-.104	-.411	.362	1.472	17.443	2.084	2.179
	Pr141	60.964	28.189	-2.629	-.335	-1.349	.955	3.796	45.164	5.387	5.702
	Ho165	9.484	4.275	-.689	-.059	-.237	.141	.572	6.807	.788	.836
	Lu175	3.443	1.539	-.248	-.007	-.025	.051	.214	2.550	.299	.307
	Gd158	41.663	18.969	-2.014	-.151	-.596	.638	2.599	30.906	3.849	3.813

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Covariance Matrices[a]

V3		Ti47	Mn55	Zn66	Ga69	Rb85	Sr88	Y89	Zr90	Nb93	Ba137
3.00	Ti47	2336.886	1718.954	-206.576	373.007	1665.481	12.579	246.268	1764.595	684.438	26.975
	Mn55	1718.954	2306.263	1565.241	519.726	1811.435	11.074	219.925	1385.763	518.190	23.160
	Zn66	-206.576	1565.241	5571.538	622.289	1739.219	5.342	30.829	-525.389	-7.084	24.519
	Ga69	373.007	519.726	622.289	150.895	531.668	2.619	47.931	186.222	120.320	7.362
	Rb85	1665.481	1811.435	1739.219	531.668	2440.876	11.686	230.214	1198.019	640.061	24.200
	Sr88	12.579	11.074	5.342	2.619	11.686	.092	1.539	11.105	4.081	.176
	Y89	246.268	219.925	30.829	47.931	230.214	1.539	33.524	233.067	83.824	2.627
	Zr90	1764.595	1385.763	-525.389	186.222	1198.019	11.105	233.067	4220.146	557.325	12.893
	Nb93	684.438	518.190	-7.084	120.320	640.061	4.081	83.824	557.325	243.326	6.713
	Ba137	26.975	23.160	24.519	7.362	24.200	.176	2.627	12.893	6.713	.677
	Fe57	60506.299	80806.139	75964.642	21072.675	65297.298	388.398	6809.632	29964.289	16607.990	1143.492
	Ce140	231.497	200.562	.234	39.867	219.646	1.489	31.639	245.783	84.602	1.797
	Nd146	141.621	130.806	10.397	26.444	132.471	.894	19.676	143.446	49.292	1.219
	Sm147	46.874	42.904	3.004	8.835	41.418	.282	6.300	43.373	15.620	.464
	Eu153	.217	.242	.134	.056	.196	.001	.024	.129	.059	.003
	Tb159	10.040	9.252	2.149	2.045	9.654	.063	1.366	9.231	3.426	.106
	Dy163	62.292	56.551	12.968	12.455	60.116	.395	8.514	58.863	21.504	.646
	Er166	33.704	30.364	6.826	6.667	32.438	.217	4.655	33.538	11.657	.363
	Tm169	5.076	4.398	.626	.954	4.769	.032	.702	5.067	1.761	.053
	Yb172	34.190	28.821	2.358	6.083	31.867	.221	4.686	35.073	12.032	.333
	Pr141	33.682	30.203	5.123	6.427	32.980	.223	4.667	32.626	12.140	.310
	Ho165	12.197	11.046	2.135	2.396	11.588	.079	1.673	12.387	4.187	.130
	Lu175	4.543	3.838	.528	.855	4.332	.029	.620	4.355	1.590	.047
	Gd158	53.223	51.198	11.944	11.116	48.637	.326	7.137	47.855	17.376	.585

Covariance Matrices[a]

V3		Ti47	Mn55	Zn66	Ga69	Rb85	Sr88	Y89	Zr90	Nb93	Ba137
4.00	Ti47	2241.231	736.142	-249.453	6.161	42.984	52.085	22.485	651.055	56.542	362.521
	Mn55	736.142	875.321	121.420	28.743	-23.461	14.454	23.297	142.914	60.070	70.764
	Zn66	-249.453	121.420	957.580	102.531	562.032	3.659	38.450	270.919	37.694	-.450
	Ga69	6.161	28.743	102.531	15.296	86.942	.797	5.897	44.615	9.903	1.411
	Rb85	42.984	-23.461	562.032	86.942	742.966	3.977	39.717	314.109	71.890	.224
	Sr88	52.085	14.454	3.659	.797	3.977	1.837	.793	25.189	-.492	13.172
	Y89	22.485	23.297	38.450	5.897	39.717	.793	7.443	57.468	9.799	1.332
	Zr90	651.055	142.914	270.919	44.615	314.109	25.189	57.468	721.785	48.614	161.635
	Nb93	56.542	60.070	37.694	9.903	71.890	-.492	9.799	48.614	25.678	-12.317
	Ba137	362.521	70.764	-.450	1.411	.224	13.172	1.332	161.635	-12.317	100.771
	Fe57	11547.297	12097.817	1319.138	359.674	-2182.693	177.957	340.529	2085.380	1041.220	848.361
	Ce140	219.933	70.856	33.911	8.478	37.430	6.781	8.885	139.257	10.321	46.399
	Nd146	59.449	21.018	31.672	4.804	28.135	2.245	5.441	63.656	5.445	14.111
	Sm147	9.943	5.269	8.402	1.243	8.219	.380	1.484	14.093	1.687	1.990
	Eu153	.507	.125	.059	.011	.043	.018	.012	.296	-.002	.133
	Tb159	1.110	.891	1.611	.247	1.638	.043	.288	2.413	.367	.154
	Dy163	7.284	6.107	10.188	1.587	10.532	.274	1.876	15.495	2.427	.926
	Er166	3.386	3.157	5.715	.879	6.017	.128	1.082	8.656	1.409	.321
	Tm169	.563	.541	.968	.148	.994	.021	.175	1.394	.230	.052
	Yb172	3.964	3.836	6.588	1.024	6.856	.138	1.175	9.261	1.601	.314
	Pr141	17.984	5.819	7.398	1.184	7.246	.656	1.303	16.617	1.268	4.210
	Ho165	1.451	1.349	2.123	.335	2.163	.053	.390	3.157	.514	.158
	Lu175	.487	.493	.915	.140	.930	.019	.161	1.271	.213	.044
	Gd158	7.159	4.630	8.164	1.221	7.987	.279	1.506	13.358	1.798	1.247

Covariance Matrices[a]

V3		Ti47	Mn55	Zn66	Ga69	Rb85	Sr88	Y89	Zr90	Nb93	Ba137
Total	Ti47	10145.596	-673.001	-2452.238	-363.270	-2163.337	252.420	-261.856	2278.772	-991.983	1835.242
	Mn55	-673.001	1361.512	598.209	138.112	489.249	-29.545	99.778	-4.380	294.935	-248.730
	Zn66	-2452.238	598.209	3488.746	483.618	2579.398	-77.574	300.671	592.413	951.662	-554.548
	Ga69	-363.270	138.112	483.618	82.382	443.200	-12.943	52.983	109.320	169.542	-94.757
	Rb85	-2163.337	489.249	2579.398	443.200	2845.561	-74.146	315.644	725.741	1040.781	-537.772
	Sr88	252.420	-29.545	-77.574	-12.943	-74.146	7.647	-10.227	47.117	-38.850	55.480
	Y89	-261.856	99.778	300.671	52.983	315.644	-10.227	46.237	128.321	141.757	-74.378
	Zr90	2278.772	-4.380	592.413	109.320	725.741	47.117	128.321	1898.565	280.858	342.565
	Nb93	-991.983	294.935	951.662	169.542	1040.781	-38.850	141.757	280.858	479.540	-276.419
	Ba137	1835.242	-248.730	-554.548	-94.757	-537.772	55.480	-74.378	342.565	-276.419	414.313
	Fe57	33459.006	15993.675	27616.025	5065.232	19696.300	263.137	3198.086	21998.253	9579.128	1988.212
	Ce140	1695.136	-199.500	-270.288	-47.186	-271.572	43.527	-32.965	485.683	-140.552	319.529
	Nd146	276.086	-4.409	52.859	8.831	50.234	5.887	9.741	159.975	18.488	43.273
	Sm147	-10.484	13.798	51.896	8.920	52.483	-.979	7.904	35.575	23.505	-6.859
	Eu153	3.257	-.359	-1.178	-.196	-1.232	.095	-.155	.504	-.594	.680
	Tb159	-9.973	3.933	13.078	2.268	13.421	-.413	1.951	5.886	6.033	-2.954
	Dy163	-66.865	25.603	83.694	14.509	86.321	-2.698	12.530	36.685	38.790	-19.382
	Er166	-38.439	14.042	44.873	7.811	46.619	-1.485	6.800	19.097	20.802	-10.762
	Tm169	-5.489	2.098	6.509	1.138	6.822	-.210	.998	2.849	3.018	-1.535
	Yb172	-34.950	13.796	41.814	7.362	44.400	-1.335	6.474	18.616	19.529	-9.797
	Pr141	110.524	-8.267	-1.175	-.329	-1.680	2.654	.360	45.295	-2.475	19.412
	Ho165	-13.182	5.184	16.190	2.916	16.677	-.524	2.439	7.103	7.482	-3.783
	Lu175	-4.772	1.850	5.626	.990	5.897	-.179	.865	2.411	2.582	-1.317
	Gd158	-43.301	19.795	68.286	11.764	68.670	-1.977	10.156	33.979	31.144	-14.056

Covariance Matrices[a]

V3		Fe57	Ce140	Nd146	Sm147	Eu153	Tb159	Dy163	Er166	Tm169	Yb172
1.00	Ti47	11220.861	168.193	70.598	16.999	.331	3.063	19.554	11.297	1.711	11.671
	Mn55	13710.957	88.291	33.246	9.478	.015	1.804	11.536	5.979	.970	6.642
	Zn66	7745.341	23.068	5.695	.519	.067	.179	1.365	2.029	.358	2.809
	Ga69	1118.813	7.437	2.392	.394	.025	.072	.479	.482	.086	.643
	Rb85	1918.190	20.530	10.465	2.467	.035	.419	2.698	1.696	.267	1.724
	Sr88	220.383	4.278	1.749	.337	.014	.065	.407	.285	.045	.325
	Y89	783.256	12.638	5.706	1.408	.024	.287	1.890	1.282	.211	1.480
	Zr90	5692.893	126.870	56.966	12.544	.283	2.359	14.545	7.721	1.113	6.916
	Nb93	1200.750	17.104	8.064	2.217	.009	.408	2.616	1.286	.192	1.206
	Ba137	1125.814	23.128	10.652	2.059	.072	.459	2.787	1.798	.288	2.078
	Fe57	331545.29	2019.854	654.933	152.902	3.253	28.619	182.380	120.627	20.223	147.589
	Ce140	2019.854	29.812	11.795	2.583	.060	.490	3.141	1.962	.311	2.170
	Nd146	654.933	11.795	5.240	1.169	.024	.229	1.455	.872	.137	.927
	Sm147	152.902	2.583	1.169	.299	.005	.056	.358	.217	.034	.229
	Eu153	3.253	.060	.024	.005	.000	.001	.006	.004	.001	.005
	Tb159	28.619	.490	.229	.056	.001	.011	.072	.045	.007	.048
	Dy163	182.380	3.141	1.455	.358	.006	.072	.472	.300	.048	.330
	Er166	120.627	1.962	.872	.217	.004	.045	.300	.217	.036	.256
	Tm169	20.223	.311	.137	.034	.001	.007	.048	.036	.006	.044
	Yb172	147.589	2.170	.927	.229	.005	.048	.330	.256	.044	.321
	Pr141	185.499	3.085	1.306	.296	.006	.057	.363	.221	.035	.236
	Ho165	43.686	.652	.288	.072	.001	.015	.098	.067	.011	.078
	Lu175	21.864	.309	.127	.032	.001	.007	.047	.039	.007	.050
	Gd158	162.085	2.745	1.268	.309	.005	.062	.397	.243	.039	.259

Covariance Matrices[a]

V3		Fe57	Ce140	Nd146	Sm147	Eu153	Tb159	Dy163	Er166	Tm169	Yb172
2.00	Ti47	30554.972	570.301	230.867	47.261	1.255	6.759	42.898	24.436	3.587	23.560
	Mn55	19495.533	250.683	102.767	22.209	.455	3.083	20.316	11.471	1.684	10.725
	Zn66	2247.785	-47.043	-18.591	-2.118	-.222	-.285	-1.697	-1.016	-.170	-1.360
	Ga69	-67.201	-6.395	-2.357	-.175	-.028	-.010	-.090	-.034	-.008	-.104
	Rb85	-2180.342	-20.247	-7.867	-.969	-.067	-.043	-.577	-.284	-.052	-.411
	Sr88	453.857	8.889	3.590	.717	.019	.104	.672	.375	.065	.362
	Y89	1944.613	33.158	13.605	2.959	.063	.431	2.752	1.562	.229	1.472
	Zr90	22027.841	400.708	163.475	35.065	.788	5.113	32.549	18.444	2.703	17.443
	Nb93	2729.558	46.569	19.087	4.136	.084	.608	3.931	2.210	.323	2.064
	Ba137	2511.276	52.243	21.147	4.255	.108	.626	4.063	2.264	.334	2.179
	Fe57	469545.89	6039.947	2475.407	547.985	11.466	74.072	474.434	269.478	39.219	253.921
	Ce140	6039.947	106.416	43.229	9.045	.211	1.315	8.445	4.766	.699	4.534
	Nd146	2475.407	43.229	17.652	3.714	.085	.540	3.461	1.960	.286	1.861
	Sm147	547.985	9.045	3.714	.823	.017	.116	.740	.418	.061	.396
	Eu153	11.466	.211	.085	.017	.000	.002	.016	.009	.001	.009
	Tb159	74.072	1.315	.540	.116	.002	.017	.109	.062	.009	.059
	Dy163	474.434	8.445	3.461	.740	.016	.109	.701	.397	.058	.375
	Er166	269.478	4.766	1.960	.418	.009	.062	.397	.226	.033	.213
	Tm169	39.219	.699	.286	.061	.001	.009	.058	.033	.005	.031
	Yb172	253.921	4.534	1.861	.396	.009	.059	.375	.213	.031	.202
	Pr141	681.406	11.836	4.835	1.041	.023	.151	.962	.543	.080	.515
	Ho165	102.102	1.769	.724	.154	.003	.023	.145	.082	.012	.078
	Lu175	36.581	.648	.266	.057	.001	.008	.054	.031	.004	.029
	Gd158	456.901	8.014	3.284	.704	.015	.103	.659	.374	.055	.354

Covariance Matrices[a]

V3		Fe57	Ce140	Nd146	Sm147	Eu153	Tb159	Dy163	Er166	Tm169	Yb172
3.00	Ti47	60506.299	231.497	141.621	46.874	.217	10.040	62.292	33.704	5.076	34.190
	Mn55	80806.139	200.562	130.806	42.904	.242	9.252	56.551	30.364	4.398	28.821
	Zn66	75964.642	.234	10.397	3.004	.134	2.149	12.988	6.626	.626	2.358
	Ga69	21072.675	39.667	26.444	8.835	.056	2.045	12.455	6.667	.954	6.083
	Rb85	66297.298	219.646	132.471	41.418	.196	9.654	60.116	32.438	4.789	31.887
	Sr88	388.398	1.489	.894	.282	.001	.063	.395	.217	.032	.221
	Y89	6809.632	31.639	19.676	6.300	.024	1.388	8.514	4.655	.702	4.688
	Zr90	29964.289	245.783	143.446	43.373	.129	9.231	58.883	33.538	5.087	35.073
	Nb93	16607.990	84.502	49.292	15.620	.059	3.426	21.504	11.657	1.761	12.032
	Ba137	1143.492	1.797	1.219	.484	.003	.106	.646	.363	.053	.333
	Fe57	3337975.5	5434.097	3734.430	1300.657	9.000	289.132	1743.837	933.371	133.192	846.270
	Ce140	5434.097	33.245	19.389	6.024	.021	1.301	8.183	4.479	.672	4.618
	Nd146	3734.430	19.389	11.984	3.760	.014	.807	5.046	2.746	.414	2.791
	Sm147	1300.657	6.024	3.760	1.229	.005	.258	1.602	.875	.132	.879
	Eu153	9.000	.021	.014	.005	3.16E-005	.001	.006	.003	.000	.003
	Tb159	289.132	1.301	.807	.258	.001	.056	.351	.191	.029	.192
	Dy163	1743.837	8.183	5.046	1.602	.006	.351	2.198	1.199	.180	1.207
	Er166	933.371	4.479	2.746	.875	.003	.191	1.199	.658	.099	.661
	Tm169	133.192	.672	.414	.132	.000	.029	.180	.099	.015	.100
	Yb172	846.270	4.618	2.791	.879	.003	.192	1.207	.661	.100	.678
	Pr141	888.747	4.692	2.818	.883	.003	.193	1.210	.660	.099	.676
	Ho165	339.994	1.613	.995	.317	.001	.069	.430	.236	.035	.238
	Lu175	117.714	.597	.365	.116	.000	.025	.159	.087	.013	.088
	Gd158	1642.091	6.612	4.208	1.382	.006	.294	1.822	.991	.149	.984

Covariance Matrices[a]

V3		Fe57	Ce140	Nd146	Sm147	Eu153	Tb159	Dy163	Er166	Tm169	Yb172
4.00	Ti47	11547.297	219.933	59.449	9.943	.507	1.110	7.284	3.386	.563	3.954
	Mn55	12097.817	70.856	21.018	5.269	.125	.891	6.107	3.157	.541	3.836
	Zn66	1319.138	33.911	31.672	8.402	.059	1.611	10.188	5.715	.968	6.588
	Ga69	359.674	8.478	4.804	1.243	.011	.247	1.587	.879	.148	1.024
	Rb85	-2182.693	37.430	28.135	8.219	.043	1.638	10.532	6.017	.994	6.856
	Sr88	177.967	6.781	2.245	.380	.018	.043	.274	.128	.021	.138
	Y89	340.529	6.685	5.441	1.464	.012	.288	1.876	1.082	.175	1.175
	Zr90	2085.380	139.257	63.656	14.093	.296	2.413	15.495	8.656	1.394	9.261
	Nb93	1041.220	10.321	5.445	1.687	-.002	.387	2.427	1.409	.230	1.601
	Ba137	848.361	46.399	14.111	1.990	.133	.154	.926	.321	.052	.314
	Fe57	282066.85	1353.747	356.967	77.467	1.903	11.088	77.269	40.061	6.456	44.186
	Ce140	1353.747	38.214	13.553	2.626	.078	.401	2.565	1.380	.219	1.496
	Nd146	356.967	13.553	6.273	1.357	.027	.230	1.487	.822	.133	.893
	Sm147	77.467	2.626	1.357	.351	.005	.060	.387	.217	.035	.238
	Eu153	1.903	.078	.027	.005	.000	.001	.004	.002	.000	.002
	Tb159	11.088	.401	.230	.060	.001	.012	.076	.043	.007	.047
	Dy163	77.269	2.565	1.487	.387	.004	.076	.491	.281	.046	.306
	Er166	40.061	1.380	.822	.217	.002	.043	.281	.163	.026	.176
	Tm169	6.456	.219	.133	.035	.000	.007	.046	.026	.004	.029
	Yb172	44.186	1.496	.893	.238	.002	.047	.306	.176	.029	.194
	Pr141	86.643	3.680	1.571	.340	.008	.056	.360	.197	.032	.216
	Ho165	17.203	.522	.303	.080	.001	.016	.102	.058	.009	.064
	Lu175	5.744	.202	.122	.032	.000	.006	.042	.024	.004	.026
	Gd158	62.329	2.284	1.264	.321	.004	.061	.394	.225	.036	.244

Covariance Matrices[a]

V3		Fe57	Ce140	Nd146	Sm147	Eu153	Tb159	Dy163	Er166	Tm169	Yb172
Total	Ti47	33459.006	1695.136	276.086	-10.484	3.257	-9.973	-66.865	-38.439	-5.489	-34.950
	Mn55	15993.675	-199.500	-4.409	13.798	-.359	3.933	25.603	14.042	2.096	13.796
	Zn66	27616.025	-270.288	52.859	51.896	-1.178	13.078	83.694	44.873	6.509	41.814
	Ga69	5065.232	-47.186	8.831	8.920	-.196	2.268	14.509	7.811	1.138	7.362
	Rb85	19696.300	-271.572	50.234	52.483	-1.232	13.421	86.321	46.619	6.822	44.400
	Sr88	263.137	43.527	5.887	-.979	.095	-.413	-2.698	-1.485	-.210	-1.335
	Y89	3198.086	-32.965	9.741	7.904	-.155	1.951	12.530	6.800	.998	6.474
	Zr90	21998.253	485.680	159.975	35.575	.504	5.886	36.685	19.097	2.849	18.616
	Nb93	9579.128	-140.552	18.488	23.505	-.594	6.033	38.790	20.802	3.018	19.529
	Ba137	1988.212	319.529	43.273	-6.889	.680	-2.954	-19.382	-10.762	-1.535	-9.797
	Fe57	977525.41	6520.755	2507.152	756.656	1.989	143.578	893.908	460.919	66.359	426.089
	Ce140	6520.755	320.296	57.799	.994	.547	-1.164	-8.004	-4.732	-.664	-4.165
	Nd146	2507.152	57.799	17.008	3.226	.069	.469	2.877	1.459	.220	1.446
	Sm147	756.656	.994	3.226	1.561	-.017	.343	2.186	1.165	.171	1.103
	Eu153	1.989	.547	.069	-.017	.001	-.006	-.041	-.023	-.003	-.021
	Tb159	143.578	-1.164	.469	.343	-.006	.083	.535	.288	.042	.272
	Dy163	893.908	-8.004	2.877	2.186	-.041	.535	3.431	1.850	.271	1.753
	Er166	460.919	-4.732	1.459	1.165	-.023	.288	1.850	1.008	.148	.961
	Tm169	66.359	-.664	.220	.171	-.003	.042	.271	.148	.022	.142
	Yb172	426.089	-4.165	1.446	1.103	-.021	.272	1.753	.961	.142	.930
	Pr141	649.501	21.765	5.023	.576	.033	.033	.172	.062	.011	.083
	Ho165	172.695	-1.569	.552	.423	-.008	.104	.666	.361	.053	.343
	Lu175	56.832	-.573	.190	.147	-.003	.036	.234	.129	.019	.125
	Gd158	818.673	-4.458	2.822	1.838	-.030	.437	2.791	1.497	.219	1.411

Covariance Matrices[a]

V3		Pr141	Ho165	Lu175	Gd158
1.00	Ti47	18.315	3.696	1.501	16.838
	Mn55	9.197	2.381	.826	10.145
	Zn66	1.255	.716	.597	1.654
	Ga69	.598	.146	.118	.453
	Rb85	2.355	.528	.261	2.678
	Sr88	.437	.092	.049	.335
	Y89	1.438	.407	.217	1.566
	Zr90	14.484	2.576	.822	13.312
	Nb93	2.050	.455	.131	2.330
	Ba137	2.543	.655	.309	2.129
	Fe57	185.499	43.686	21.864	162.085
	Ce140	3.085	.652	.309	2.745
	Nd146	1.306	.288	.127	1.268
	Sm147	.296	.072	.032	.309
	Eu153	.006	.001	.001	.005
	Tb159	.057	.015	.007	.062
	Dy163	.353	.098	.047	.397
	Er166	.221	.067	.039	.243
	Tm169	.035	.011	.007	.039
	Yb172	.238	.078	.050	.259
	Pr141	.338	.073	.033	.318
	Ho165	.073	.022	.012	.081
	Lu175	.033	.012	.008	.036
	Gd158	.318	.081	.036	.344

Covariance Matrices[a]

V3		Pr141	Ho165	Lu175	Gd158
2.00	Ti47	60.964	9.484	3.443	41.663
	Mn55	28.189	4.275	1.539	18.969
	Zn66	-2.629	-.689	-.248	-2.014
	Ga69	-.335	-.059	-.007	-.151
	Rb85	-1.349	-.237	-.025	-.596
	Sr88	.955	.141	.051	.638
	Y89	3.795	.572	.214	2.599
	Zr90	45.164	6.807	2.550	30.906
	Nb93	5.367	.788	.299	3.649
	Ba137	5.702	.806	.307	3.813
	Fe57	681.406	102.102	36.581	456.901
	Ce140	11.836	1.769	.648	8.014
	Nd146	4.835	.724	.266	3.284
	Sm147	1.041	.154	.057	.704
	Eu153	.023	.003	.001	.015
	Tb159	.151	.023	.008	.103
	Dy163	.962	.145	.054	.659
	Er166	.543	.082	.031	.374
	Tm169	.080	.012	.004	.055
	Yb172	.515	.078	.029	.354
	Pr141	1.347	.200	.074	.912
	Ho165	.200	.030	.011	.137
	Lu175	.074	.011	.004	.051
	Gd158	.912	.137	.051	.623

Covariance Matrices[a]

V3		Pr141	Ho165	Lu175	Gd158
3.00	Ti47	33.682	12.197	4.543	53.223
	Mn55	30.203	11.046	3.838	51.198
	Zn66	5.123	2.135	.528	11.944
	Ga69	6.427	2.396	.855	11.116
	Rb85	32.980	11.588	4.332	48.637
	Sr88	.223	.079	.029	.326
	Y89	4.667	1.673	.620	7.137
	Zr90	32.626	12.387	4.355	47.855
	Nb93	12.140	4.187	1.590	17.376
	Ba137	.310	.130	.047	.585
	Fe57	868.747	339.994	117.714	1642.091
	Ce140	4.692	1.613	.597	6.612
	Nd146	2.818	.986	.365	4.208
	Sm147	.883	.317	.116	1.362
	Eu153	.003	.001	.000	.006
	Tb159	.193	.069	.025	.294
	Dy163	1.210	.430	.159	1.822
	Er166	.660	.236	.087	.991
	Tm169	.099	.035	.013	.149
	Yb172	.676	.238	.088	.984
	Pr141	.686	.238	.088	.987
	Ho165	.238	.086	.031	.357
	Lu175	.088	.031	.012	.131
	Gd158	.987	.357	.131	1.566

Covariance Matrices[a]

V3		Pr141	Ho165	Lu175	Gd158
4.00	Ti47	17.984	1.451	.487	7.159
	Mn55	5.819	1.349	.493	4.630
	Zn66	7.398	2.123	.915	8.164
	Ga69	1.184	.335	.140	1.221
	Rb85	7.246	2.163	.930	7.987
	Sr88	.656	.053	.019	.279
	Y89	1.303	.390	.161	1.506
	Zr90	16.617	3.157	1.271	13.358
	Nb93	1.268	.514	.213	1.798
	Ba137	4.210	.158	.044	1.247
	Fe57	86.643	17.203	5.744	62.329
	Ce140	3.680	.522	.202	2.284
	Nd146	1.571	.303	.122	1.264
	Sm147	.340	.086	.032	.321
	Eu153	.008	.001	.000	.004
	Tb159	.056	.016	.006	.061
	Dy163	.360	.102	.042	.394
	Er166	.197	.058	.024	.225
	Tm169	.032	.009	.004	.036
	Yb172	.216	.064	.026	.244
	Pr141	.425	.073	.029	.310
	Ho165	.073	.022	.009	.082
	Lu175	.029	.009	.004	.033
	Gd158	.310	.082	.033	.325

Covariance Matrices[a]

V3		Pr141	Ho165	Lu175	Gd158
Total	Ti47	110.524	-13.182	-4.772	-43.301
	Mn55	-8.267	5.184	1.850	19.795
	Zn66	-1.175	16.190	5.626	68.286
	Ga69	-.329	2.616	.990	11.764
	Rb85	-1.680	16.677	5.897	68.670
	Sr88	2.654	-.524	-.179	-1.977
	Y89	.380	2.439	.865	10.196
	Zr90	45.295	7.103	2.411	33.979
	Nb93	-2.475	7.482	2.582	31.144
	Ba137	19.412	-3.783	-1.317	-14.066
	Fe57	649.501	172.695	56.832	818.673
	Ce140	21.765	-1.589	-.573	-4.458
	Nd146	5.023	.552	.190	2.822
	Sm147	.576	.423	.147	1.838
	Eu153	.033	-.008	-.003	-.030
	Tb159	.033	.104	.036	.437
	Dy163	.172	.666	.234	2.791
	Er166	.062	.361	.129	1.497
	Tm169	.011	.053	.019	.219
	Yb172	.083	.343	.125	1.411
	Pr141	1.681	.031	.010	.298
	Ho165	.031	.130	.046	.541
	Lu175	.010	.046	.017	.188
	Gd158	.298	.541	.188	2.306

a. The total covariance matrix has 242 degrees of freedom.

Analysis 1

Box's Test of Equality of Covariance Matrices

Log Determinants

V3	Rank	Log Determinant
1.00	15	11.906
2.00	a	b
3.00	15	11.315
4.00	15	16.098
Pooled within-groups	15	20.633

The ranks and natural logarithms of determinants printed are those of the group covariance matrices.

a. Rank < 9

b. Too few cases to be non-singular

Test Results[a]

Box's M		1465.970
F	Approx.	5.018
	df1	240
	df2	17565.483
	Sig.	.000

Tests null hypothesis of equal population covariance matrices.

a. Some covariance matrices are singular and the usual procedure will not work. The non-singular groups will be tested against their own pooled within-groups covariance matrix. The log of its determinant is 21.144.

Stepwise Statistics

Variables Entered/Removed[a,b,c,d]

		Wilks' Lambda							
						Exact F			
Step	Entered	Statistic	df1	df2	df3	Statistic	df1	df2	Sig.
1	Nb93	.105	1	3	239.000	682.472	3	239.000	.000
2	Ce140	.011	2	3	239.000	674.302	6	476.000	.000
3	Eu153	.004	3	3	239.000				
4	Sr88	.002	4	3	239.000				
5	Ti47	.001	5	3	239.000				
6	Mn55	.001	6	3	239.000				
7	Zn66	.001	7	3	239.000				
8	Rb85	.000	8	3	239.000				
9	Pr141	.000	9	3	239.000				
10	Sm147	.000	10	3	239.000				
11	Y89	.000	11	3	239.000				
12	Gd158	.000	12	3	239.000				
13	Fe57	.000	13	3	239.000				
14	Ga69	.000	14	3	239.000				
15	Nd146	.000	15	3	239.000				

At each step, the variable that minimizes the overall Wilks' Lambda is entered.

Variables Entered/Removed[a,b,c,d]

	Wilks' Lambda			
	Approximate F			
Step	Statistic	df1	df2	Sig.
1				
2				
3	567.219	9	576.946	.000
4	550.711	12	624.689	.000
5	464.148	15	649.133	.000
6	408.183	18	662.337	.000
7	379.006	21	669.600	.000
8	400.965	24	673.472	.000
9	377.828	27	675.281	.000
10	353.435	30	675.771	.000
11	332.344	33	675.380	.000
12	323.854	36	674.379	.000
13	309.283	39	672.943	.000
14	294.408	42	671.190	.000
15	283.350	45	669.198	.000

At each step, the variable that minimizes the overall Wilks' Lambda is entered.

a. Maximum number of steps is 48.

b. Minimum partial F to enter is 3.84.

c. Maximum partial F to remove is 2.71.

d. F level, tolerance, or VIN insufficient for further computation.

Variables in the Analysis

Step		Tolerance	F to Remove	Wilks' Lambda
1	Nb93	1.000	682.472	
2	Nb93	.779	770.104	.119
	Ce140	.779	669.024	.105
3	Nb93	.447	258.186	.016
	Ce140	.127	610.375	.033
	Eu153	.162	149.978	.011

Variables in the Analysis

Step		Tolerance	F to Remove	Wilks' Lambda
4	Nb93	.437	261.257	.007
	Ce140	.126	496.239	.011
	Eu153	.093	225.942	.006
	Sr88	.161	117.405	.004
5	Nb93	.338	320.595	.006
	Ce140	.126	367.552	.006
	Eu153	.092	178.633	.004
	Sr88	.127	162.453	.003
	Ti47	.257	29.100	.002
6	Nb93	.321	236.938	.004
	Ce140	.126	229.632	.003
	Eu153	.092	151.159	.003
	Sr88	.127	161.538	.003
	Ti47	.237	27.923	.001
	Mn55	.579	22.593	.001
7	Nb93	.305	193.253	.002
	Ce140	.126	195.416	.002
	Eu153	.088	155.832	.002
	Sr88	.123	167.698	.002
	Ti47	.160	40.774	.001
	Mn55	.484	37.544	.001
	Zn66	.633	26.102	.001
8	Nb93	.141	244.167	.002
	Ce140	.117	197.458	.001
	Eu153	.088	154.861	.001
	Sr88	.115	141.949	.001
	Ti47	.159	41.251	.001
	Mn55	.345	70.935	.001
	Zn66	.300	79.268	.001
	Rb85	.221	59.352	.001

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Variables in the Analysis

Step		Tolerance	F to Remove	Wilks' Lambda
9	Nb93	.116	147.263	.001
	Ce140	.068	113.108	.001
	Eu153	.083	62.305	.001
	Sr88	.110	146.615	.001
	Ti47	.131	52.180	.001
	Mn55	.345	70.412	.001
	Zn66	.300	75.304	.001
	Rb85	.219	60.118	.001
	Pr141	.072	17.740	.000
10	Nb93	.109	62.614	.000
	Ce140	.062	75.445	.001
	Eu153	.081	62.016	.000
	Sr88	.109	147.494	.001
	Ti47	.127	52.688	.000
	Mn55	.329	77.298	.001
	Zn66	.296	70.773	.000
	Rb85	.218	51.574	.000
	Pr141	.038	12.689	.000
	Sm147	.101	11.985	.000
11	Nb93	.095	60.937	.000
	Ce140	.059	75.744	.000
	Eu153	.081	61.714	.000
	Sr88	.109	141.474	.001
	Ti47	.124	35.653	.000
	Mn55	.327	61.509	.000
	Zn66	.296	62.010	.000
	Rb85	.217	49.530	.000
	Pr141	.037	12.598	.000
	Sm147	.065	20.666	.000
	Y89	.082	10.266	.000

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Variables in the Analysis

Step		Tolerance	F to Remove	Wilks' Lambda
12	Nb93	.095	47.606	.000
	Ce140	.058	71.105	.000
	Eu153	.079	63.933	.000
	Sr88	.105	145.282	.001
	Ti47	.123	33.783	.000
	Mn55	.326	51.926	.000
	Zn66	.292	34.684	.000
	Rb85	.216	32.317	.000
	Pr141	.035	15.044	.000
	Sm147	.065	4.328	.000
	Y89	.041	25.038	.000
	Gd158	.028	16.695	.000
13	Nb93	.092	51.497	.000
	Ce140	.057	49.942	.000
	Eu153	.074	71.328	.000
	Sr88	.103	134.686	.000
	Ti47	.119	28.592	.000
	Mn55	.262	47.017	.000
	Zn66	.240	29.518	.000
	Rb85	.207	34.469	.000
	Pr141	.032	14.077	.000
	Sm147	.055	4.154	.000
	Y89	.041	24.953	.000
	Gd158	.027	17.369	.000
	Fe57	.259	9.685	.000

Variables in the Analysis

Step		Tolerance	F to Remove	Wilks' Lambda
14	Nb93	.092	51.337	.000
	Ce140	.056	54.313	.000
	Eu153	.073	51.087	.000
	Sr88	.101	134.037	.000
	Ti47	.108	31.643	.000
	Mn55	.262	46.376	.000
	Zn66	.207	25.876	.000
	Rb85	.107	20.020	.000
	Pr141	.030	17.252	.000
	Sm147	.054	4.518	.000
	Y89	.041	24.575	.000
	Gd158	.026	17.846	.000
	Fe57	.156	13.245	.000
	Ga69	.078	7.309	.000
15	Nb93	.091	51.568	.000
	Ce140	.046	63.521	.000
	Eu153	.071	35.073	.000
	Sr88	.100	129.369	.000
	Ti47	.104	33.124	.000
	Mn55	.260	46.543	.000
	Zn66	.203	27.685	.000
	Rb85	.107	19.979	.000
	Pr141	.029	11.636	.000
	Sm147	.051	4.726	.000
	Y89	.041	24.093	.000
	Gd158	.023	22.308	.000
	Fe57	.156	11.991	.000
	Ga69	.076	8.734	.000
	Nd146	.029	8.523	.000

Variables Not in the Analysis

Step		Tolerance	Min. Tolerance	F to Enter	Wilks' Lambda
0	Ti47	1.000	1.000	297.711	.211
	Mn55	1.000	1.000	24.341	.766

Variables Not in the Analysis

Step		Tolerance	Min. Tolerance	F to Enter	Wilks' Lambda
0	Zn66	1.000	1.000	114.210	.411
	Ga69	1.000	1.000	141.909	.360
	Rb85	1.000	1.000	196.471	.289
	Sr88	1.000	1.000	320.673	.199
	Y89	1.000	1.000	275.838	.224
	Zr90	1.000	1.000	54.840	.592
	Nb93	1.000	1.000	682.472	.105
	Ba137	1.000	1.000	291.186	.215
	Fe57	1.000	1.000	45.603	.636
	Ce140	1.000	1.000	591.780	.119
	Nd146	1.000	1.000	113.748	.412
	Sm147	1.000	1.000	198.251	.287
	Eu153	1.000	1.000	476.906	.143
	Tb159	1.000	1.000	325.556	.197
	Dy163	1.000	1.000	326.828	.196
	Er166	1.000	1.000	276.472	.224
	Tm169	1.000	1.000	224.954	.262
	Yb172	1.000	1.000	198.797	.286
	Pr141	1.000	1.000	209.181	.276
	Ho165	1.000	1.000	282.353	.220
	Lu175	1.000	1.000	177.325	.310
	Gd158	1.000	1.000	313.265	.203

Variables Not in the Analysis

Step		Tolerance	Min. Tolerance	F to Enter	Wilks' Lambda
1	Ti47	.801	.801	294.937	.022
	Mn55	.710	.710	47.173	.066
	Zn66	.995	.995	9.683	.093
	Ga69	.753	.753	.492	.104
	Rb85	.629	.629	10.781	.092
	Sr88	1.000	1.000	155.380	.035
	Y89	.390	.390	5.699	.098
	Zr90	.773	.773	78.992	.052
	Ba137	.989	.989	150.483	.036
	Fe57	.751	.751	54.217	.062
	Ce140	.779	.779	669.024	.011
	Nd146	.656	.656	202.057	.029
	Sm147	.504	.504	64.536	.058
	Eu153	.991	.991	169.235	.033
	Tb159	.394	.394	13.861	.089
	Dy163	.391	.391	8.960	.094
	Er166	.448	.448	3.346	.100
	Tm169	.474	.474	3.786	.100
	Yb172	.474	.474	5.227	.098
	Pr141	.688	.688	335.331	.020
	Ho165	.435	.435	6.301	.097
	Lu175	.542	.542	3.769	.100
	Gd158	.446	.446	28.420	.077

Variables Not in the Analysis

Step		Tolerance	Min. Tolerance	F to Enter	Wilks' Lambda
2	Ti47	.391	.380	17.839	.009
	Mn55	.651	.648	52.918	.007
	Zn66	.988	.773	10.266	.010
	Ga69	.741	.647	1.665	.011
	Rb85	.629	.536	10.128	.010
	Sr88	.281	.219	68.389	.006
	Y89	.296	.296	25.912	.008
	Zr90	.415	.415	18.868	.009
	Ba137	.379	.299	40.662	.007
	Fe57	.707	.689	6.305	.010
	Nd146	.155	.155	64.325	.006
	Sm147	.280	.280	47.358	.007
	Eu153	.162	.127	149.978	.004
	Tb159	.266	.266	34.603	.008
	Dy163	.267	.267	32.174	.008
	Er166	.334	.334	24.425	.008
	Tm169	.361	.361	22.989	.009
	Yb172	.360	.360	24.554	.008
	Pr141	.114	.114	44.197	.007
	Ho165	.308	.308	29.606	.008
	Lu175	.426	.426	21.855	.009
	Gd158	.280	.280	44.619	.007

Variables Not in the Analysis

Step		Tolerance	Min. Tolerance	F to Enter	Wilks' Lambda
3	Ti47	.325	.127	8.816	.003
	Mn55	.650	.126	20.631	.003
	Zn66	.983	.127	10.596	.003
	Ga69	.704	.124	.927	.004
	Rb85	.596	.121	14.791	.003
	Sr88	.161	.093	117.405	.002
	Y89	.290	.125	5.320	.004
	Zr90	.407	.119	4.207	.004
	Ba137	.300	.126	60.630	.002
	Fe57	.688	.127	4.745	.004
	Nd146	.148	.099	19.295	.003
	Sm147	.250	.121	22.551	.003
	Tb159	.260	.124	12.999	.003
	Dy163	.261	.124	10.862	.003
	Er166	.329	.125	6.787	.004
	Tm169	.356	.125	6.136	.004
	Yb172	.358	.124	8.089	.003
	Pr141	.106	.086	10.444	.003
	Ho165	.305	.123	9.582	.003
	Lu175	.422	.125	6.270	.004
	Gd158	.270	.125	23.121	.003

Variables Not in the Analysis

Step		Tolerance	Min. Tolerance	F to Enter	Wilks' Lambda
4	Ti47	.257	.092	29.100	.001
	Mn55	.630	.092	23.694	.001
	Zn66	.978	.092	10.898	.001
	Ga69	.702	.089	1.092	.002
	Rb85	.592	.091	6.556	.001
	Y89	.284	.089	6.381	.001
	Zr90	.407	.092	4.191	.001
	Ba137	.095	.051	15.688	.001
	Fe57	.686	.090	2.052	.001
	Nd146	.145	.087	12.858	.001
	Sm147	.247	.088	17.758	.001
	Tb159	.256	.089	11.830	.001
	Dy163	.256	.089	10.971	.001
	Er166	.321	.089	8.358	.001
	Tm169	.350	.090	7.581	.001
	Yb172	.353	.091	9.179	.001
	Pr141	.106	.088	6.271	.001
	Ho165	.301	.091	9.805	.001
	Lu175	.415	.090	7.744	.001
	Gd158	.261	.088	19.727	.001

Variables Not in the Analysis

Step		Tolerance	Min. Tolerance	F to Enter	Wilks' Lambda
5	Mn55	.579	.092	22.593	.001
	Zn66	.758	.091	12.602	.001
	Ga69	.598	.087	3.829	.001
	Rb85	.477	.090	12.690	.001
	Y89	.212	.087	3.874	.001
	Zr90	.384	.091	3.303	.001
	Ba137	.094	.048	15.611	.001
	Fe57	.654	.090	.567	.001
	Nd146	.098	.082	20.513	.001
	Sm147	.193	.086	21.124	.001
	Tb159	.175	.086	12.912	.001
	Dy163	.175	.086	9.530	.001
	Er166	.235	.087	3.486	.001
	Tm169	.259	.088	3.517	.001
	Yb172	.264	.089	5.823	.001
	Pr141	.074	.074	19.161	.001
	Ho165	.218	.089	7.811	.001
	Lu175	.318	.089	3.915	.001
	Gd158	.200	.083	19.967	.001
6	Zn66	.633	.088	26.102	.001
	Ga69	.528	.085	9.230	.001
	Rb85	.466	.090	12.905	.001
	Y89	.207	.085	2.165	.001
	Zr90	.374	.091	4.669	.001
	Ba137	.093	.048	12.893	.001
	Fe57	.349	.084	22.749	.001
	Nd146	.098	.082	20.302	.001
	Sm147	.190	.084	22.506	.001
	Tb159	.171	.084	13.688	.001
	Dy163	.171	.085	9.763	.001
	Er166	.233	.086	2.643	.001
	Tm169	.256	.087	1.821	.001
	Yb172	.262	.088	3.189	.001
	Pr141	.074	.074	19.135	.001
	Ho165	.211	.087	6.846	.001
	Lu175	.316	.087	2.084	.001
	Gd158	.193	.081	22.744	.001

Variables Not in the Analysis

Step		Tolerance	Min. Tolerance	F to Enter	Wilks' Lambda
7	Ga69	.205	.084	13.498	.001
	Rb85	.221	.088	59.352	.000
	Y89	.207	.082	2.170	.001
	Zr90	.372	.087	4.499	.001
	Ba137	.092	.045	14.299	.001
	Fe57	.303	.084	11.525	.001
	Nd146	.098	.080	18.788	.001
	Sm147	.190	.082	19.150	.001
	Tb159	.170	.082	11.083	.001
	Dy163	.170	.082	8.194	.001
	Er166	.232	.083	2.561	.001
	Tm169	.255	.084	2.038	.001
	Yb172	.261	.085	3.235	.001
	Pr141	.072	.072	17.107	.001
	Ho165	.210	.084	6.209	.001
	Lu175	.315	.085	2.456	.001
	Gd158	.192	.079	17.460	.001
8	Ga69	.160	.083	.909	.000
	Y89	.207	.082	2.208	.000
	Zr90	.370	.087	4.872	.000
	Ba137	.091	.044	7.158	.000
	Fe57	.287	.083	11.932	.000
	Nd146	.098	.080	17.163	.000
	Sm147	.188	.082	16.994	.000
	Tb159	.169	.082	10.133	.000
	Dy163	.170	.082	7.238	.000
	Er166	.232	.083	2.493	.000
	Tm169	.255	.084	1.954	.000
	Yb172	.261	.085	2.663	.000
	Pr141	.072	.068	17.740	.000
	Ho165	.210	.084	5.953	.000
	Lu175	.315	.085	2.093	.000
	Gd158	.192	.079	12.319	.000

Variables Not in the Analysis

Step		Tolerance	Min. Tolerance	F to Enter	Wilks' Lambda
9	Ga69	.147	.066	1.980	.000
	Y89	.126	.044	2.480	.000
	Zr90	.313	.061	2.293	.000
	Ba137	.091	.042	7.585	.000
	Fe57	.273	.068	8.618	.000
	Nd146	.061	.037	4.415	.000
	Sm147	.101	.038	11.985	.000
	Tb159	.090	.038	4.417	.000
	Dy163	.093	.039	3.363	.000
	Er166	.159	.050	2.670	.000
	Tm169	.183	.052	3.171	.000
	Yb172	.198	.055	4.011	.000
	Ho165	.139	.048	2.207	.000
	Lu175	.265	.061	2.465	.000
	Gd158	.101	.038	11.672	.000
10	Ga69	.144	.035	2.056	.000
	Y89	.082	.037	10.266	.000
	Zr90	.298	.037	1.897	.000
	Ba137	.091	.038	7.219	.000
	Fe57	.268	.036	9.377	.000
	Nd146	.035	.033	5.135	.000
	Tb159	.054	.035	.702	.000
	Dy163	.059	.035	2.330	.000
	Er166	.116	.038	6.917	.000
	Tm169	.139	.038	9.563	.000
	Yb172	.165	.038	9.523	.000
	Ho165	.098	.037	2.671	.000
	Lu175	.223	.038	6.554	.000
	Gd158	.056	.035	3.116	.000

Variables Not in the Analysis

Step		Tolerance	Min. Tolerance	F to Enter	Wilks' Lambda
11	Ga69	.141	.033	2.796	.000
	Zr90	.289	.036	1.778	.000
	Ba137	.090	.037	4.731	.000
	Fe57	.265	.034	9.040	.000
	Nd146	.033	.033	6.731	.000
	Tb159	.021	.021	8.906	.000
	Dy163	.020	.020	5.554	.000
	Er166	.028	.020	2.009	.000
	Tm169	.038	.022	1.346	.000
	Yb172	.063	.031	2.344	.000
	Ho165	.040	.033	4.295	.000
	Lu175	.085	.031	1.883	.000
	Gd158	.028	.028	16.695	.000
12	Ga69	.129	.026	3.966	.000
	Zr90	.283	.027	1.913	.000
	Ba137	.082	.026	2.231	.000
	Fe57	.259	.027	9.685	.000
	Nd146	.030	.026	8.368	.000
	Tb159	.010	.010	4.546	.000
	Dy163	.014	.014	1.766	.000
	Er166	.027	.017	1.662	.000
	Tm169	.037	.018	1.400	.000
	Yb172	.060	.019	1.725	.000
	Ho165	.037	.026	2.902	.000
	Lu175	.081	.019	2.318	.000
13	Ga69	.078	.026	7.309	.000
	Zr90	.279	.027	1.109	.000
	Ba137	.082	.026	2.625	.000
	Nd146	.029	.025	7.101	.000
	Tb159	.010	.010	3.655	.000
	Dy163	.012	.012	.646	.000
	Er166	.026	.017	.359	.000
	Tm169	.033	.017	.971	.000
	Yb172	.065	.019	.280	.000
	Ho165	.036	.026	1.485	.000
	Lu175	.078	.019	.994	.000

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Variables Not in the Analysis

Step		Tolerance	Min. Tolerance	F to Enter	Wilks' Lambda
14	Zr90	.276	.025	1.398	.000
	Ba137	.081	.024	3.152	.000
	Nd146	.029	.023	8.523	.000
	Tb159	.009	.009	2.436	.000
	Dy163	.012	.012	.555	.000
	Er166	.026	.017	.389	.000
	Tm169	.033	.016	.997	.000
	Yb172	.055	.018	.267	.000
	Ho165	.036	.024	1.172	.000
	Lu175	.077	.018	.643	.000
15	Zr90	.274	.022	.939	.000
	Ba137	.080	.021	2.699	.000
	Tb159	.009	.009	1.935	.000
	Dy163	.012	.012	.294	.000
	Er166	.025	.017	.852	.000
	Tm169	.032	.016	1.509	.000
	Yb172	.053	.018	.539	.000
	Ho165	.036	.021	1.636	.000
	Lu175	.074	.018	.973	.000

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Wilks' Lambda

Step	Number of Variables	Lambda	df1	df2	df3	Exact F			
						Statistic	df1	df2	Sig.
1	1	.105	1	3	239	682.472	3	239.000	.000
2	2	.011	2	3	239	674.302	6	476.000	.000
3	3	.004	3	3	239				
4	4	.002	4	3	239				
5	5	.001	5	3	239				
6	6	.001	6	3	239				
7	7	.001	7	3	239				
8	8	.000	8	3	239				
9	9	.000	9	3	239				
10	10	.000	10	3	239				
11	11	.000	11	3	239				
12	12	.000	12	3	239				
13	13	.000	13	3	239				
14	14	.000	14	3	239				
15	15	.000	15	3	239				

Wilks' Lambda

Step	Approximate F			
	Statistic	df1	df2	Sig.
1				
2				
3	567.219	9	576.946	.000
4	550.711	12	624.689	.000
5	464.148	15	649.133	.000
6	408.183	18	662.337	.000
7	379.008	21	669.600	.000
8	400.965	24	673.472	.000
9	377.828	27	675.281	.000
10	353.435	30	675.771	.000
11	332.344	33	675.380	.000
12	323.854	36	674.379	.000
13	309.283	39	672.943	.000
14	294.408	42	671.190	.000
15	283.350	45	669.198	.000

Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o]

Step	V3		1.00	2.00	3.00	4.00
1	1.00	F		36.704	1419.760	3.260
		Sig.		.000	.000	.072
	2.00	F	36.704		888.482	54.615
		Sig.	.000		.000	.000
	3.00	F	1419.760	888.482		1854.040
		Sig.	.000	.000		.000
	4.00	F	3.260	54.615	1854.040	
		Sig.	.072	.000	.000	
2	1.00	F		689.757	820.755	671.310
		Sig.		.000	.000	.000
	2.00	F	689.757		1433.693	246.070
		Sig.	.000		.000	.000
	3.00	F	820.755	1433.693		2076.591
		Sig.	.000	.000		.000

Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o]

Step	V3		1.00	2.00	3.00	4.00
2	4.00	F	671.310	246.070	2076.591	
		Sig.	.000	.000	.000	
3	1.00	F		796.232	636.622	1186.615
		Sig.		.000	.000	.000
	2.00	F	796.232		1081.889	200.225
		Sig.	.000		.000	.000
	3.00	F	636.622	1081.889		1502.461
		Sig.	.000	.000		.000
	4.00	F	1186.615	200.225	1502.461	
		Sig.	.000	.000	.000	
4	1.00	F		653.584	601.518	912.662
		Sig.		.000	.000	.000
	2.00	F	653.584		1017.479	266.029
		Sig.	.000		.000	.000
	3.00	F	601.518	1017.479		1203.660
		Sig.	.000	.000		.000
	4.00	F	912.662	266.029	1203.660	
		Sig.	.000	.000	.000	
5	1.00	F		637.426	574.462	745.181
		Sig.		.000	.000	.000
	2.00	F	637.426		1083.400	301.006
		Sig.	.000		.000	.000
	3.00	F	574.462	1083.400		1185.493
		Sig.	.000	.000		.000
	4.00	F	745.181	301.006	1185.493	
		Sig.	.000	.000	.000	
6	1.00	F		570.102	540.499	717.838
		Sig.		.000	.000	.000
	2.00	F	570.102		900.021	253.300
		Sig.	.000		.000	.000
	3.00	F	540.499	900.021		985.186
		Sig.	.000	.000		.000
	4.00	F	717.838	253.300	985.186	
		Sig.	.000	.000	.000	
7	1.00	F		538.472	504.405	665.072
		Sig.		.000	.000	.000

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Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o]

Step	V3		1.00	2.00	3.00	4.00
7	2.00	F	538.472		775.293	232.919
		Sig.	.000		.000	.000
	3.00	F	504.405	775.293		844.039
		Sig.	.000	.000		.000
	4.00	F	665.072	232.919	844.039	
		Sig.	.000	.000	.000	
8	1.00	F		470.672	638.661	580.034
		Sig.		.000	.000	.000
	2.00	F	470.672		779.151	203.812
		Sig.	.000		.000	.000
	3.00	F	638.661	779.151		1035.414
		Sig.	.000	.000		.000
	4.00	F	580.034	203.812	1035.414	
		Sig.	.000	.000	.000	
9	1.00	F		422.179	579.741	525.641
		Sig.		.000	.000	.000
	2.00	F	422.179		711.529	198.780
		Sig.	.000		.000	.000
	3.00	F	579.741	711.529		918.992
		Sig.	.000	.000		.000
	4.00	F	525.641	198.780	918.992	
		Sig.	.000	.000	.000	
10	1.00	F		380.014	582.482	471.435
		Sig.		.000	.000	.000
	2.00	F	380.014		677.335	179.286
		Sig.	.000		.000	.000
	3.00	F	582.482	677.335		921.672
		Sig.	.000	.000		.000
	4.00	F	471.435	179.286	921.672	
		Sig.	.000	.000	.000	
11	1.00	F		347.250	544.441	426.716
		Sig.		.000	.000	.000
	2.00	F	347.250		613.930	166.131
		Sig.	.000		.000	.000
	3.00	F	544.441	613.930		858.662
		Sig.	.000	.000		.000

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Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o]

Step	V3		1.00	2.00	3.00	4.00
11	4.00	F	425.716	166.131	858.662	
		Sig.	.000	.000	.000	
12	1.00	F		317.017	592.763	389.958
		Sig.		.000	.000	.000
	2.00	F	317.017		603.079	152.094
		Sig.	.000		.000	.000
	3.00	F	592.763	603.079		904.381
		Sig.	.000	.000		.000
	4.00	F	389.958	152.094	904.381	
		Sig.	.000	.000	.000	
13	1.00	F		315.773	545.208	401.839
		Sig.		.000	.000	.000
	2.00	F	315.773		580.573	143.749
		Sig.	.000		.000	.000
	3.00	F	545.208	580.573		869.892
		Sig.	.000	.000		.000
	4.00	F	401.839	143.749	869.892	
		Sig.	.000	.000	.000	
14	1.00	F		291.934	520.645	384.715
		Sig.		.000	.000	.000
	2.00	F	291.934		543.064	135.874
		Sig.	.000		.000	.000
	3.00	F	520.645	543.064		807.507
		Sig.	.000	.000		.000
	4.00	F	384.715	135.874	807.507	
		Sig.	.000	.000	.000	
15	1.00	F		271.811	523.184	374.390
		Sig.		.000	.000	.000
	2.00	F	271.811		515.514	127.860
		Sig.	.000		.000	.000
	3.00	F	523.184	515.514		766.568
		Sig.	.000	.000		.000
	4.00	F	374.390	127.860	766.568	
		Sig.	.000	.000	.000	

a. 1, 239 degrees of freedom for step 1.
b. 2, 238 degrees of freedom for step 2.
c. 3, 237 degrees of freedom for step 3.
d. 4, 236 degrees of freedom for step 4.

Pairwise Group Comparisons[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o]

e. 5, 235 degrees of freedom for step 5.
f. 6, 234 degrees of freedom for step 6.
g. 7, 233 degrees of freedom for step 7.
h. 8, 232 degrees of freedom for step 8.
i. 9, 231 degrees of freedom for step 9.
j. 10, 230 degrees of freedom for step 10.
k. 11, 229 degrees of freedom for step 11.
l. 12, 228 degrees of freedom for step 12.
m. 13, 227 degrees of freedom for step 13.
n. 14, 226 degrees of freedom for step 14.
o. 15, 225 degrees of freedom for step 15.

Summary of Canonical Discriminant Functions

Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	58.939[a]	68.1	68.1	.992
2	23.558[a]	27.2	95.4	.979
3	4.019[a]	4.6	100.0	.895

a. First 3 canonical discriminant functions were used in the analysis.

Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 3	.000	2071.001	45	.000
2 through 3	.008	1119.302	28	.000
3	.199	375.964	13	.000

Standardized Canonical Discriminant Function Coefficients

	Function		
	1	2	3
Ti47	-.699	.040	-1.750
Mn55	-.249	-1.161	.388
Zn66	.772	.717	-.560
Ga69	-.254	-.877	-.842
Rb85	-.829	.128	1.265
Sr88	1.456	.996	2.034
Y89	-1.510	-1.215	1.703
Nb93	2.126	.092	.055
Fe57	-.389	.750	.493
Ce140	-.616	2.835	1.572
Nd146	-.684	-1.882	-.690
Sm147	.633	.419	-.864
Eu153	.393	-2.048	-.602
Pr141	-1.739	-.722	-1.225
Gd158	2.378	2.080	-.696

Structure Matrix

	Function		
	1	2	3
Nb93	.354*	.221	-.088
Eu153	-.315*	.065	-.108
Sr88	-.245*	.133	.133
Dy163[a]	.244*	.172	-.141
Tb159[a]	.243*	.182	-.152
Ba137[a]	-.241*	.162	.169
Y89	.224*	.141	-.103
Gd158	.221*	.193	-.210
Er166[a]	.221*	.162	-.100
Ho165[a]	.220*	.172	-.106
Tm169[a]	.218*	.146	-.085
Ti47	-.217*	.194	-.128
Yb172[a]	.191*	.141	-.056
Rb85	.185*	.134	.088
Lu175[a]	.166*	.129	-.033
Ga69	.162*	.095	-.064
Zn66	.139*	.105	-.097
Ce140	-.269	.363*	-.109
Pr141	-.120	.265*	-.169
Nd146	-.040	.225*	-.188
Zr90[a]	-.027	.221*	-.119
Mn55	.054	-.074*	-.040
Sm147	.149	.205	-.215*
Fe57	.021	.139	-.150*

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions

Variables ordered by absolute size of correlation within function.

*. Largest absolute correlation between each variable and any discriminant function

a. This variable not used in the analysis.

Canonical Discriminant Function Coefficients

	Function		
	1	2	3
Ti47	-.015	.001	-.038
Mn55	-.008	-.038	.012
Zn66	.020	.019	-.015
Ga69	-.048	-.160	-.154
Rb85	-.029	.004	.044
Sr88	1.173	.802	1.639
Y89	-.466	-.375	.526
Nb93	.298	.013	.008
Fe57	.000	.001	.001
Ce140	-.099	.457	.253
Nd146	-.257	-.632	-.259
Sm147	.940	.623	-1.284
Eu153	28.387	-147.879	-43.489
Pr141	-2.538	-1.054	-1.787
Gd158	3.456	3.024	-.954
(Constant)	2.773	-11.216	4.314

Unstandardized coefficients

Functions at Group Centroids

	Function		
V3	1	2	3
1.00	2.871	-10.089	-.878
2.00	-14.513	4.281	-9.235
3.00	19.439	5.003	-1.259
4.00	-3.156	1.587	.892

Unstandardized canonical discriminant functions evaluated at group means

Classification Statistics

Classification Processing Summary

Processed		282
Excluded	Missing or out-of-range group codes	0
	At least one missing discriminating variable	5
Used in Output		277

Prior Probabilities for Groups

		Cases Used in Analysis	
V3	Prior	Unweighted	Weighted
1.00	.250	43	43.000
2.00	.250	9	9.000
3.00	.250	27	27.000
4.00	.250	164	164.000
Total	1.000	243	243.000

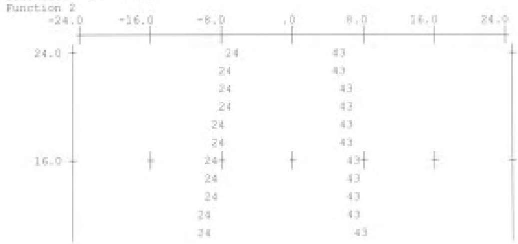
Classification Function Coefficients

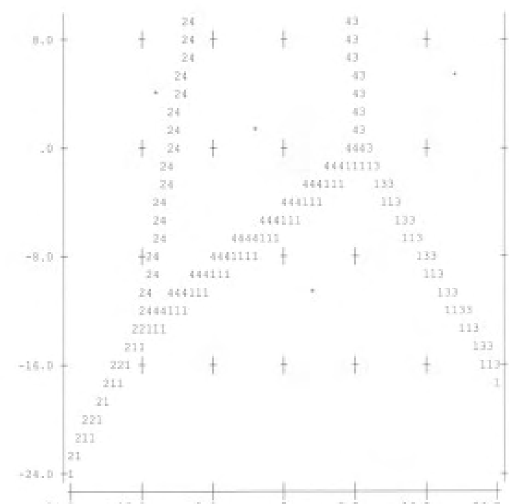
	V3			
	1.00	2.00	3.00	4.00
Ti47	.355	.950	.141	.397
Mn55	.458	-.024	-.215	.106
Zn66	.400	.444	1.028	.475
Ga69	-.878	-1.059	-3.973	-2.709
Rb85	.061	.250	-.374	.356
Sr88	-18.308	-41.183	12.275	-13.436
Y89	1.778	-.007	-11.910	1.033
Nb93	1.399	-3.669	6.534	-.237
Fe57	-.013	.004	-.007	.002
Ce140	1.640	7.764	6.745	7.972
Nd146	-1.864	-4.259	-15.498	-8.096
Sm147	5.006	8.591	30.727	4.592
Eu153	1265.092	-981.282	-471.055	-700.775
Pr141	-16.262	28.004	-73.176	-16.077
Gd158	-17.980	-26.448	85.464	-5.004
(Constant)	-253.958	-602.123	-526.801	-346.245

Fisher's linear discriminant functions

Territorial Map
(Assuming all functions but the first two are zero)

Canonical Discriminant
Function 2





Canonical Discriminant Function 1

```
Symbols used in territorial map

Symbol  Group  Label
------  -----  --------------------

   1      1
   2      2
   3      3
   4      4
   *             Indicates a group centroid
```


Casewise Statistics

	Case Number	Actual Group	Highest Group: Predicted Group	Highest Group: P(D>d | G=g) p	Highest Group: P(D>d | G=g) df	Highest Group: P(G=g | D=d)	Highest Group: Squared Mahalanobis Distance to Centroid
Original	1	1	1	.705	3	1.000	1.404
	2	1	1	.673	3	1.000	1.541
	3	1	1	.273	3	1.000	3.900
	4	1	1	.806	3	1.000	.980
	5	1	1	.750	3	1.000	1.211
	6	1	1	.627	3	1.000	1.745
	7	1	1	.547	3	1.000	2.126
	8	1	1	.811	3	1.000	.960
	9	1	1	.926	3	1.000	.469
	10	1	1	.868	3	1.000	.723
	11	1	1	.423	3	1.000	2.802
	12	1	1	.059	3	1.000	7.447
	13	1	1	.871	3	1.000	.708
	14	1	1	.164	3	1.000	5.106
	15	1	1	.497	3	1.000	2.384
	16	1	1	.889	3	1.000	.633
	17	1	1	.459	3	1.000	2.590
	18	1	1	.211	3	1.000	4.515
	19	1	1	.318	3	1.000	3.522
	20	1	1	.615	3	1.000	1.800
	21	1	1	.966	3	1.000	.269
	22	1	1	.000	3	1.000	33.422
	23	1	1	.920	3	1.000	.497
	24	1	1	.902	3	1.000	.576
	25	1	1	.771	3	1.000	1.123
	26	1	1	.568	3	1.000	2.023
	27	1	1	.602	3	1.000	1.859
	28	1	1	.698	3	1.000	1.434
	29	1	1	.350	3	1.000	3.283
	30	1	1	.912	3	1.000	.532
	31	1	1	.799	3	1.000	1.008
	32	1	1	.662	3	1.000	1.589
	33	1	1	.381	3	1.000	3.071

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Actual Group	Highest Group				
			Predicted Group	P(D>d | G=g)		P(G=g | D=d)	Squared Mahalanobis Distance to Centroid
				p	df		
Original	34	2	2	.000	3	1.000	24.834
	35	2	2	.579	3	1.000	1.969
	36	2	2	.371	3	1.000	3.135
	37	2	2	.204	3	1.000	4.591
	38	2	2	.032	3	1.000	8.798
	39	2	2	.906	3	1.000	.556
	40	2	2	.834	3	1.000	.862
	41	2	2	.757	3	1.000	1.184
	42	2	2	.887	3	1.000	.642
	43	ungrouped	4	.000	3	1.000	36.872
	44	ungrouped	4	.204	3	1.000	4.598
	45	ungrouped	4	.082	3	1.000	6.715
	46	ungrouped	4	.021	3	1.000	9.780
	47	ungrouped	4	.021	3	1.000	9.706
	48	ungrouped	4	.979	3	1.000	.190
	49	ungrouped	1	.000	3	1.000	175.764
	50	ungrouped	4	.003	3	1.000	14.130
	51	ungrouped	4	.678	3	1.000	1.516
	52	ungrouped	4	.051	3	1.000	7.791
	53	ungrouped	4	.953	3	1.000	.338
	54	ungrouped	4	.918	3	1.000	.502
	55	ungrouped	4	.182	3	1.000	4.869
	56	ungrouped	4	.339	3	1.000	3.360
	57	ungrouped	4	.838	3	1.000	.850
	58	ungrouped	4	.550	3	1.000	2.111
	59	ungrouped	4	.356	3	1.000	3.242
	60	ungrouped	4	.861	3	1.000	.750
	61	ungrouped	4	.394	3	1.000	2.988
	62	ungrouped	4	.039	3	1.000	8.361
	63	ungrouped	4	.518	3	1.000	2.273
	64	ungrouped	4	.002	3	1.000	15.101
	65	ungrouped	4	.984	3	1.000	.158
	66	ungrouped	4	.722	3	1.000	1.330

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

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Casewise Statistics

	Case Number	Actual Group	Highest Group				
			Predicted Group	P(D>d | G=g)		P(G=g | D=d)	Squared Mahalanobis Distance to Centroid
				p	df		
Original	67	3	3	.807	3	1.000	.976
	68	3	3	.716	3	1.000	1.356
	69	3	3	.503	3	1.000	2.349
	70	3	3	.306	3	1.000	3.613
	71	3	3	.003	3	1.000	13.856
	72	3	3	.010	3	1.000	11.259
	73	3	3	.200	3	1.000	4.640
	74	3	3	.366	3	1.000	3.170
	75	3	3	.320	3	1.000	3.506
	76	3	3	.334	3	1.000	3.402
	77	3	3	.053	3	1.000	7.701
	78	3	3	.965	3	1.000	.271
	79	3	3	.885	3	1.000	.650
	80	3	3	.751	3	1.000	1.208
	81	3	3	.569	3	1.000	2.015
	82	3	3	.301	3	1.000	3.659
	83	3	3	.810	3	1.000	.965
	84	4	4	.896	3	1.000	.602
	85	4	4	.726	3	1.000	1.312
	86	4	4	.585	3	1.000	1.942
	87	4	4	.939	3	1.000	.408
	88	4	4	.384	3	1.000	3.050
	89	4	4	.797	3	1.000	1.018
	90	4	4	.720	3	1.000	1.338
	91	4	4	.010	3	1.000	11.310
	92	4	4	.292	3	1.000	3.732
	93	4	4	.460	3	1.000	2.586
	94	4	4	.448	3	1.000	2.657
	95	4	4	.958	3	1.000	.310
	96	4	4	.196	3	1.000	4.690
	97	4	4	.372	3	1.000	3.129
	98	4	4	.716	3	1.000	1.356
	99	4	4	.547	3	1.000	2.126

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

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Casewise Statistics

	Case Number	Actual Group	Highest Group				
			Predicted Group	P(D>d | G=g)		P(G=g | D=d)	Squared Mahalanobis Distance to Centroid
				p	df		
Original	100	4	4	.790	3	1.000	1.046
	101	4	4	.722	3	1.000	1.329
	102	4	4	.198	3	1.000	4.671
	103	4	4	.963	3	1.000	.284
	104	4	4	.993	3	1.000	.088
	105	4	4	.684	3	1.000	1.494
	106	4	4	.396	3	1.000	2.974
	107	4	4	.659	3	1.000	1.600
	108	4	4	.451	3	1.000	2.635
	109	4	4	.786	3	1.000	1.065
	110	4	4	.893	3	1.000	.615
	111	4	4	.932	3	1.000	.440
	112	4	4	.895	3	1.000	.606
	113	4	4	.671	3	1.000	1.549
	114	4	4	.426	3	1.000	2.784
	115	4	4	.763	3	1.000	1.160
	116	4	4	.920	3	1.000	.493
	117	4	4	.990	3	1.000	.113
	118	4	4	.934	3	1.000	.429
	119	4	4	.956	3	1.000	.322
	120	4	4	.424	3	1.000	2.799
	121	4	4	.286	3	1.000	3.779
	122	4	4	.991	3	1.000	.104
	123	4	4	.565	3	1.000	2.036
	124	4	4	.976	3	1.000	.211
	125	4	4	.667	3	1.000	1.566
	126	4	4	.600	3	1.000	1.867
	127	4	4	.926	3	1.000	.469
	128	4	4	.875	3	1.000	.694
	129	4	4	.881	3	1.000	.665
	130	4	4	.739	3	1.000	1.259
	131	4	4	.721	3	1.000	1.334
	132	4	4	.623	3	1.000	1.765

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Actual Group	Highest Group				
			Predicted Group	P(D>d | G=g)		P(G=g | D=d)	Squared Mahalanobis Distance to Centroid
				p	df		
Original	133	4	4	.872	3	1.000	.707
	134	4	4	.607	3	1.000	1.838
	135	4	4	.103	3	1.000	6.188
	136	4	4	.157	3	1.000	5.209
	137	4	4	.013	3	1.000	10.799
	138	4	4	.267	3	1.000	3.945
	139	4	4	.039	3	1.000	8.379
	140	4	4	.375	3	1.000	3.110
	141	4	4	.986	3	1.000	.145
	142	4	4	.772	3	1.000	1.121
	143	4	4	.875	3	1.000	.694
	144	4	4	.404	3	1.000	2.921
	145	4	4	.419	3	1.000	2.827
	146	4	4	.171	3	1.000	5.005
	147	4	4	.271	3	1.000	3.915
	148	4	4	.190	3	1.000	4.759
	149	4	4	.701	3	1.000	1.421
	150	4	4	.356	3	1.000	3.240
	151	4	4	.342	3	1.000	3.343
	152	4	4	.571	3	1.000	2.006
	153	4	4	.013	3	1.000	10.739
	154	4	4	.288	3	1.000	3.762
	155	4	4	.017	3	1.000	10.232
	156	4	4	.762	3	1.000	1.161
	157	4	4	.982	3	1.000	.174
	158	4	4	.388	3	1.000	3.021
	159	4	4	.027	3	1.000	9.211
	160	4	4	.002	3	1.000	14.786
	161	4	4	.284	3	1.000	3.796
	162	4	4	.172	3	1.000	4.997
	163	4	4	.003	3	1.000	13.659
	164	4	4	.683	3	1.000	1.499
	165	4	4	.386	3	1.000	3.035

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

			Highest Group				
				P(D>d | G=g)			Squared Mahalanobis Distance to Centroid
	Case Number	Actual Group	Predicted Group	p	df	P(G=g | D=d)	
Original	166	4	4	.506	3	1.000	2.336
	167	4	4	.586	3	1.000	1.933
	168	4	4	.356	3	1.000	3.242
	169	4	4	.886	3	1.000	.645
	170	4	4	.402	3	1.000	2.931
	171	4	4	.462	3	1.000	2.574
	172	4	4	.993	3	1.000	.091
	173	4	4	.000	3	1.000	25.609
	174	4	4	.105	3	1.000	6.144
	175	4	4	.634	3	1.000	1.714
	176	4	4	.432	3	1.000	2.747
	177	4	4	.571	3	1.000	2.006
	178	4	4	.828	3	1.000	.890
	179	4	4	.922	3	1.000	.488
	180	4	4	.588	3	1.000	1.927
	181	4	4	.958	3	1.000	.311
	182	4	4	.641	3	1.000	1.684
	183	4	4	.999	3	1.000	.030
	184	4	4	.798	3	1.000	1.012
	185	4	4	.961	3	1.000	.293
	186	4	4	.751	3	1.000	1.210
	187	4	4	.548	3	1.000	2.119
	188	4	4	.258	3	1.000	4.035
	189	4	4	.167	3	1.000	5.060
	190	4	4	.289	3	1.000	3.756
	191	4	4	.410	3	1.000	2.881
	192	4	4	.000	3	1.000	48.466
	193	4	4	.695	3	1.000	1.443
	194	4	4	.926	3	1.000	.468
	195	4	4	.537	3	1.000	2.174
	196	4	4	.308	3	1.000	3.599
	197	4	4	.810	3	1.000	.966
	198	4	4	.631	3	1.000	1.725

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

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Casewise Statistics

			Highest Group				
				P(D>d | G=g)			Squared Mahalanobis Distance to Centroid
	Case Number	Actual Group	Predicted Group	p	df	P(G=g | D=d)	
Original	199	4	4	.598	3	1.000	1.881
	200	4	4	.651	3	1.000	1.636
	201	4	4	.985	3	1.000	.148
	202	4	4	.925	3	1.000	.473
	203	4	4	.711	3	1.000	1.376
	204	4	4	.919	3	1.000	.499
	205	4	4	.990	3	1.000	.112
	206	4	4	.745	3	1.000	1.232
	207	4	4	.657	3	1.000	1.608
	208	4	4	.835	3	1.000	.861
	209	4	4	.984	3	1.000	.160
	210	4	4	.807	3	1.000	.974
	211	4	4	.902	3	1.000	.575
	212	4	4	.728	3	1.000	1.305
	213	4	4	.445	3	1.000	2.672
	214	4	4	.989	3	1.000	.124
	215	4	4	.660	3	1.000	1.598
	216	4	4	.996	3	1.000	.057
	217	4	4	.996	3	1.000	.066
	218	4	4	.999	3	1.000	.024
	219	4	4	.685	3	1.000	1.488
	220	4	4	.846	3	1.000	.816
	221	4	4	.894	3	1.000	.609
	222	4	4	.774	3	1.000	1.114
	223	4	4	.402	3	1.000	2.936
	224	4	4	.383	3	1.000	3.058
	225	4	4	.153	3	1.000	5.276
	226	4	4	.837	3	1.000	.852
	227	4	4	.902	3	1.000	.575
	228	4	4	.793	3	1.000	1.035
	229	4	4	.996	3	1.000	.063
	230	4	4	.968	3	1.000	.255
	231	4	4	.792	3	1.000	1.037

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

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Casewise Statistics

	Case Number	Actual Group	Highest Group				
			Predicted Group	P(D>d | G=g)		P(G=g | D=d)	Squared Mahalanobis Distance to Centroid
				p	df		
Original	232	4	4	.620	3	1.000	1.776
	233	4	4	.757	3	1.000	1.184
	234	4	4	.921	3	1.000	.493
	235	4	4	.996	3	1.000	.058
	236	4	4	.898	3	1.000	.595
	237	4	4	.922	3	1.000	.487
	238	4	4	.619	3	1.000	1.781
	239	4	4	.532	3	1.000	2.200
	240	4	4	.771	3	1.000	1.126
	241	4	4	.420	3	1.000	2.824
	242	4	4	.949	3	1.000	.356
	243	4	4	.903	3	1.000	.569
	244	4	4	.472	3	1.000	2.520
	245	4	4	.944	3	1.000	.382
	246	4	4	.906	3	1.000	.557
	247	4	4	.958	3	1.000	.312
	249	3	3	.558	3	1.000	2.071
	250	3	3	.392	3	1.000	2.996
	251	3	3	.066	3	1.000	7.165
	252	3	3	.529	3	1.000	2.213
	253	3	3	.369	3	1.000	3.153
	254	3	3	.057	3	1.000	7.517
	255	3	3	.298	3	1.000	3.678
	256	3	3	.181	3	1.000	4.879
	257	3	3	.029	3	1.000	9.017
	258	3	3	.871	3	1.000	.709
	260	1	1	.249	3	1.000	4.116
	261	1	1	.832	3	1.000	.872
	262	1	1	.554	3	1.000	2.091
	263	1	1	.477	3	1.000	2.488
	264	1	1	.000	3	1.000	21.189
	265	1	1	.536	3	1.000	2.177
	266	1	1	.982	3	1.000	.172

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Actual Group	Highest Group				
			Predicted Group	P(D>d | G=g)		P(G=g | D=d)	Squared Mahalanobis Distance to Centroid
				p	df		
Original	267	1	1	.752	3	1.000	1.202
	268	1	1	.955	3	1.000	.327
	269	1	1	.416	3	1.000	2.843
	271	ungrouped	4	.075	3	1.000	6.902
	272	ungrouped	4	.001	3	1.000	15.798
	273	ungrouped	4	.008	3	1.000	11.867
	274	ungrouped	4	.117	3	1.000	5.886
	275	ungrouped	4	.125	3	1.000	5.747
	276	ungrouped	4	.342	3	1.000	3.338
	277	ungrouped	4	.530	3	1.000	2.208
	278	ungrouped	4	.939	3	1.000	.408
	279	ungrouped	4	.015	3	1.000	10.461
	280	ungrouped	4	.100	3	1.000	6.262

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Actual Group	Highest Group: Predicted Group	P(D>d | G=g): p	P(D>d | G=g): df	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid
Cross-validated[a]	1	1	1	.446	15	1.000	15.077
	2	1	1	.995	15	1.000	4.652
	3	1	1	.929	15	1.000	7.877
	4	1	1	.931	15	1.000	7.827
	5	1	1	.944	15	1.000	7.455
	6	1	1	.932	15	1.000	7.792
	7	1	1	.983	15	1.000	5.802
	8	1	1	.992	15	1.000	4.978
	9	1	1	.998	15	1.000	3.877
	10	1	1	.986	15	1.000	5.600
	11	1	1	.967	15	1.000	6.620
	12	1	1	.113	15	1.000	21.789
	13	1	1	.690	15	1.000	11.861
	14	1	1	.006	15	1.000	32.088
	15	1	1	.369	15	1.000	16.199
	16	1	1	.959	15	1.000	6.945
	17	1	1	.012	15	1.000	30.034
	18	1	1	.505	15	1.000	14.275
	19	1	1	.489	15	1.000	14.488
	20	1	1	.813	15	1.000	10.102
	21	1	1	.964	15	1.000	6.764
	22	1	1	.000	15	1.000	97.716
	23	1	1	.945	15	1.000	7.431
	24	1	1	.799	15	1.000	10.328
	25	1	1	.997	15	1.000	4.273
	26	1	1	.907	15	1.000	8.402
	27	1	1	.997	15	1.000	4.104
	28	1	1	.049	15	1.000	25.103
	29	1	1	.884	15	1.000	8.879
	30	1	1	.981	15	1.000	5.952
	31	1	1	.788	15	1.000	10.484
	32	1	1	.966	15	1.000	6.680
	33	1	1	.759	15	1.000	10.910

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Actual Group	Highest Group: Predicted Group	P(D>d | G=g): p	P(D>d | G=g): df	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid
Cross-validated[a]	34	2	2	.000	15	1.000	50.872
	35	2	2	.001	15	1.000	38.042
	36	2	2	.973	15	1.000	6.356
	37	2	2	.130	15	1.000	21.208
	38	2	2	.001	15	1.000	39.203
	39	2	2	.887	15	1.000	8.815
	40	2	2	.939	15	1.000	7.586
	41	2	2	.894	15	1.000	8.671
	42	2	2	.601	15	1.000	13.013
	67	3	3	.619	15	1.000	12.789
	68	3	3	.555	15	1.000	13.618
	69	3	3	.143	15	1.000	20.804
	70	3	3	.084	15	1.000	23.016
	71	3	3	.029	15	1.000	26.925
	72	3	3	.000	15	1.000	44.956
	73	3	3	.020	15	1.000	28.304
	74	3	3	.470	15	1.000	14.742
	75	3	3	.025	15	1.000	27.541
	76	3	3	.328	15	1.000	16.842
	77	3	3	.197	15	1.000	19.382
	78	3	3	.487	15	1.000	14.517
	79	3	3	.124	15	1.000	21.406
	80	3	3	.354	15	1.000	16.430
	81	3	3	.512	15	1.000	14.175
	82	3	3	.110	15	1.000	21.915
	83	3	3	.898	15	1.000	8.598
	84	4	4	.794	15	1.000	10.402
	85	4	4	.331	15	1.000	16.796
	86	4	4	.356	15	1.000	16.392
	87	4	4	.806	15	1.000	10.223
	88	4	4	.663	15	1.000	12.214
	89	4	4	.795	15	1.000	10.377
	90	4	4	.436	15	1.000	15.219

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Actual Group	Highest Group: Predicted Group	P(D>d | G=g): p	P(D>d | G=g): df	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid
Cross-validated[a]	91	4	4	.000	15	1.000	44.734
	92	4	4	.004	15	1.000	33.753
	93	4	4	.327	15	1.000	16.859
	94	4	4	.076	15	1.000	23.394
	95	4	4	.905	15	1.000	8.442
	96	4	4	.074	15	1.000	23.522
	97	4	4	.026	15	1.000	27.353
	98	4	4	.963	15	1.000	6.786
	99	4	4	.877	15	1.000	9.011
	100	4	4	.874	15	1.000	9.057
	101	4	4	.994	15	1.000	4.788
	102	4	4	.355	15	1.000	16.413
	103	4	4	.910	15	1.000	8.330
	104	4	4	.995	15	1.000	4.657
	105	4	4	.779	15	1.000	10.615
	106	4	4	.788	15	1.000	10.485
	107	4	4	.932	15	1.000	7.788
	108	4	4	.640	15	1.000	12.506
	109	4	4	.553	15	1.000	13.638
	110	4	4	.969	15	1.000	6.528
	111	4	4	.929	15	1.000	7.866
	112	4	4	.937	15	1.000	7.655
	113	4	4	.688	15	1.000	11.884
	114	4	4	.841	15	1.000	9.650
	115	4	4	.931	15	1.000	7.803
	116	4	4	.885	15	1.000	8.851
	117	4	4	.806	15	1.000	10.214
	118	4	4	.861	15	1.000	9.309
	119	4	4	.996	15	1.000	4.419
	120	4	4	.113	15	1.000	21.802
	121	4	4	.013	15	1.000	29.757
	122	4	4	.409	15	1.000	15.603
	123	4	4	.383	15	1.000	15.982

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Actual Group	Highest Group: Predicted Group	P(D>d | G=g): p	P(D>d | G=g): df	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid
Cross-validated[a]	124	4	4	.479	15	1.000	14.623
	125	4	4	.668	15	1.000	12.151
	126	4	4	.636	15	1.000	12.568
	127	4	4	.993	15	1.000	4.911
	128	4	4	.897	15	1.000	8.603
	129	4	4	.862	15	1.000	9.297
	130	4	4	.787	15	1.000	10.498
	131	4	4	.979	15	1.000	6.047
	132	4	4	.560	15	1.000	13.547
	133	4	4	.569	15	1.000	13.430
	134	4	4	.718	15	1.000	11.480
	135	4	4	.701	15	1.000	11.707
	136	4	4	.026	15	1.000	27.330
	137	4	4	.003	15	1.000	34.394
	138	4	4	.089	15	1.000	22.779
	139	4	4	.016	15	1.000	28.947
	140	4	4	.649	15	1.000	12.390
	141	4	4	.153	15	1.000	20.516
	142	4	4	.318	15	1.000	17.012
	143	4	4	.277	15	1.000	17.731
	144	4	4	.805	15	1.000	10.237
	145	4	4	.626	15	1.000	12.697
	146	4	4	.539	15	1.000	13.818
	147	4	4	.297	15	1.000	17.370
	148	4	4	.264	15	1.000	17.971
	149	4	4	.646	15	1.000	12.434
	150	4	4	.791	15	1.000	10.439
	151	4	4	.920	15	1.000	8.099
	152	4	4	.780	15	1.000	10.610
	153	4	4	.036	15	1.000	26.233
	154	4	4	.496	15	1.000	14.390
	155	4	4	.026	15	1.000	27.411
	156	4	4	.995	15	1.000	4.564

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Actual Group	Highest Group				
			Predicted Group	P(D>d | G=g)		P(G=g | D=d)	Squared Mahalanobis Distance to Centroid
				p	df		
Cross-validated[a]	157	4	4	.930	15	1.000	7.836
	158	4	4	.001	15	1.000	39.436
	159	4	4	.343	15	1.000	16.600
	160	4	4	.140	15	1.000	20.890
	161	4	4	.363	15	1.000	16.297
	162	4	4	.918	15	1.000	8.146
	163	4	4	.042	15	1.000	25.603
	164	4	4	.958	15	1.000	6.978
	165	4	4	.505	15	1.000	14.270
	166	4	4	.592	15	1.000	13.133
	167	4	4	.503	15	1.000	14.298
	168	4	4	.001	15	1.000	37.217
	169	4	4	.689	15	1.000	11.863
	170	4	4	.327	15	1.000	16.861
	171	4	4	.003	15	1.000	34.390
	172	4	4	.279	15	1.000	17.695
	173	4	4	.000	15	1.000	84.787
	174	4	4	.406	15	1.000	15.644
	175	4	4	.930	15	1.000	7.830
	176	4	4	.839	15	1.000	9.684
	177	4	4	.650	15	1.000	12.376
	178	4	4	.955	15	1.000	7.110
	179	4	4	.557	15	1.000	13.590
	180	4	4	.469	15	1.000	14.760
	181	4	4	.788	15	1.000	10.490
	182	4	4	.673	15	1.000	12.080
	183	4	4	.317	15	1.000	17.028
	184	4	4	.652	15	1.000	12.353
	185	4	4	.414	15	1.000	15.532
	186	4	4	.285	15	1.000	17.584
	187	4	4	.422	15	1.000	15.417
	188	4	4	.028	15	1.000	27.065
	189	4	4	.039	15	1.000	25.907

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Actual Group	Highest Group				
			Predicted Group	P(D>d | G=g)		P(G=g | D=d)	Squared Mahalanobis Distance to Centroid
				p	df		
Cross-validated[a]	190	4	4	.498	15	1.000	14.372
	191	4	4	.865	15	1.000	9.239
	192	4	1**	.000	15	1.000	365.356
	193	4	4	.915	15	1.000	8.212
	194	4	4	.253	15	1.000	18.190
	195	4	4	.766	15	1.000	10.812
	196	4	4	.583	15	1.000	13.245
	197	4	4	.965	15	1.000	6.730
	198	4	4	.994	15	1.000	4.785
	199	4	4	.918	15	1.000	8.143
	200	4	4	.956	15	1.000	7.053
	201	4	4	.994	15	1.000	4.689
	202	4	4	.958	15	1.000	6.995
	203	4	4	.619	15	1.000	12.787
	204	4	4	.998	15	1.000	4.034
	205	4	4	.497	15	1.000	14.380
	206	4	4	.974	15	1.000	6.333
	207	4	4	.937	15	1.000	7.652
	208	4	4	.996	15	1.000	4.582
	209	4	4	.765	15	1.000	10.819
	210	4	4	.670	15	1.000	12.115
	211	4	4	.978	15	1.000	6.094
	212	4	4	.435	15	1.000	15.228
	213	4	4	.848	15	1.000	9.532
	214	4	4	.994	15	1.000	4.800
	215	4	4	.873	15	1.000	9.080
	216	4	4	.939	15	1.000	7.594
	217	4	4	.695	15	1.000	11.792
	218	4	4	.954	15	1.000	7.136
	219	4	4	.979	15	1.000	6.040
	220	4	4	.996	15	1.000	4.338
	221	4	4	.543	15	1.000	13.764
	222	4	4	.850	15	1.000	9.491

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Actual Group	Highest Group				
			Predicted Group	P(D>d | G=g)		P(G=g | D=d)	Squared Mahalanobis Distance to Centroid
				p	df		
Cross-validated[a]	223	4	4	.835	15	1.000	9.767
	224	4	4	.933	15	1.000	7.758
	225	4	4	.884	15	1.000	8.875
	226	4	4	.743	15	1.000	11.139
	227	4	4	.992	15	1.000	5.062
	228	4	4	.940	15	1.000	7.561
	229	4	4	.972	15	1.000	6.401
	230	4	4	1.000	15	1.000	2.716
	231	4	4	.997	15	1.000	4.093
	232	4	4	.942	15	1.000	7.499
	233	4	4	.905	15	1.000	8.444
	234	4	4	.814	15	1.000	10.096
	235	4	4	.998	15	1.000	4.051
	236	4	4	.999	15	1.000	3.589
	237	4	4	.991	15	1.000	5.125
	238	4	4	.832	15	1.000	9.802
	239	4	4	.931	15	1.000	7.828
	240	4	4	.929	15	1.000	7.870
	241	4	4	.745	15	1.000	11.101
	242	4	4	.992	15	1.000	5.011
	243	4	4	.987	15	1.000	5.515
	244	4	4	.917	15	1.000	8.170
	245	4	4	.984	15	1.000	5.758
	246	4	4	.996	15	1.000	4.464
	247	4	4	.914	15	1.000	8.231
	249	3	3	.021	15	1.000	28.105
	250	3	3	.052	15	1.000	24.822
	251	3	3	.000	15	1.000	132.329
	252	3	3	.615	15	1.000	12.833
	253	3	3	.001	15	1.000	36.716
	254	3	3	.000	15	1.000	131.648
	255	3	3	.000	15	1.000	47.501
	256	3	3	.000	15	1.000	126.061

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Actual Group	Highest Group				
			Predicted Group	P(D>d | G=g)		P(G=g | D=d)	Squared Mahalanobis Distance to Centroid
				p	df		
Cross-validated[a]	257	3	3	.020	15	1.000	28.177
	258	3	3	.172	15	1.000	20.008
	260	1	1	.372	15	1.000	16.151
	261	1	1	.785	15	1.000	10.530
	262	1	1	.753	15	1.000	10.990
	263	1	1	.000	15	1.000	42.609
	264	1	1	.000	15	1.000	179.150
	265	1	1	.072	15	1.000	23.629
	266	1	1	.394	15	1.000	15.821
	267	1	1	.611	15	1.000	12.887
	268	1	1	.281	15	1.000	17.656
	269	1	1	.901	15	1.000	8.532

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Second Highest Group: Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Discriminant Scores: Function 1	Function 2	Function 3
Original	1	4	.000	192.549	2.514	-10.848	-1.514
	2	4	.000	188.511	2.075	-11.029	-.521
	3	4	.000	193.692	1.515	-11.470	-.288
	4	4	.000	183.658	2.583	-10.663	.076
	5	4	.000	197.048	2.563	-11.143	-.619
	6	4	.000	174.847	1.948	-10.587	.126
	7	4	.000	188.522	1.965	-11.109	-.164
	8	4	.000	179.623	2.123	-10.572	-1.087
	9	4	.000	185.840	2.649	-10.679	-.409
	10	4	.000	155.437	2.601	-9.414	-.236
	11	4	.000	214.576	4.206	-10.887	-1.296
	12	4	.000	226.122	4.678	-10.762	-2.608
	13	4	.000	168.478	3.075	-9.583	-1.318
	14	4	.000	138.258	2.584	-8.674	1.061
	15	4	.000	154.073	3.334	-8.761	-1.315
	16	4	.000	169.661	3.441	-9.534	-.675
	17	4	.000	174.886	2.361	-10.027	-2.203
	18	4	.000	219.855	4.339	-10.877	-1.998
	19	4	.000	180.858	3.350	-9.699	-2.450
	20	4	.000	162.615	1.706	-9.989	-1.337
	21	4	.000	172.728	2.372	-10.231	-.692
	22	4	.000	199.680	6.646	-8.298	3.318
	23	4	.000	180.649	2.579	-10.520	-.202
	24	4	.000	186.345	3.603	-10.142	-.871
	25	4	.000	175.212	2.910	-9.885	-1.717
	26	4	.000	201.614	2.873	-10.988	-1.779
	27	4	.000	185.380	4.194	-9.763	-.699
	28	4	.000	146.280	2.808	-8.897	-.780
	29	4	.000	195.094	4.572	-9.849	-1.253
	30	4	.000	157.630	2.328	-9.609	-.594
	31	4	.000	186.849	3.808	-10.017	-1.030
	32	4	.000	161.699	3.080	-9.219	-1.566
	33	4	.000	150.579	2.302	-9.029	-1.952

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Second Highest Group: Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Discriminant Scores: Function 1	Function 2	Function 3
Original	34	4	.000	410.880	-18.132	3.680	-12.608
	35	4	.000	263.554	-15.439	3.287	-9.587
	36	4	.000	291.207	-15.253	5.095	-10.622
	37	4	.000	177.889	-13.152	3.985	-7.606
	38	4	.000	157.595	-12.692	3.991	-6.912
	39	4	.000	222.133	-14.033	4.673	-8.819
	40	4	.000	211.896	-13.768	4.343	-8.685
	41	4	.000	209.117	-13.658	4.523	-8.606
	42	4	.000	251.340	-14.493	4.956	-9.666
	43	2	.000	112.750	-4.988	3.202	-4.668
	44	1	.000	197.827	-2.443	2.934	-.616
	45	1	.000	137.437	-1.673	.712	-1.045
	46	2	.000	164.267	-4.126	2.444	-1.955
	47	2	.000	189.005	-4.092	4.323	-.267
	48	1	.000	185.769	-3.197	2.019	.856
	49	4	.000	383.428	-6.275	-15.574	-8.553
	50	2	.000	153.476	-4.848	.720	-2.351
	51	1	.000	181.417	-3.115	1.971	-.276
	52	1	.000	172.853	-4.358	.861	-1.521
	53	1	.000	188.779	-3.430	2.047	.666
	54	1	.000	181.629	-2.798	1.965	1.372
	55	1	.000	229.879	-3.068	3.674	1.602
	56	1	.000	134.425	-2.666	.077	-.025
	57	1	.000	161.920	-2.571	1.207	1.494
	58	1	.000	150.676	-3.323	.282	1.508
	59	1	.000	214.999	-3.261	3.207	.114
	60	1	.000	194.550	-3.036	2.443	.942
	61	1	.000	185.339	-2.208	2.533	-.200
	62	1	.000	176.805	-.507	2.592	1.469
	63	1	.000	154.423	-3.460	.594	-.202
	64	1	.000	243.658	-1.460	4.490	2.840
	65	1	.000	169.542	-3.314	1.289	.681
	66	1	.000	163.807	-3.798	.787	.352

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Second Highest Group			Discriminant Scores		
		Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Function 1	Function 2	Function 3
Original	67	1	.000	501.090	19.015	5.416	-.468
	68	1	.000	547.017	20.140	5.684	-.626
	69	1	.000	440.596	18.611	3.765	-1.619
	70	1	.000	429.640	17.765	4.283	-1.800
	71	1	.000	367.437	16.997	2.814	.502
	72	1	.000	374.729	16.484	3.671	-.392
	73	1	.000	431.909	18.097	3.930	-2.559
	74	1	.000	583.905	20.862	6.016	-1.605
	75	1	.000	470.170	19.155	4.188	.402
	76	4	.000	546.299	19.660	6.529	-.247
	77	4	.000	528.051	19.316	6.378	1.148
	78	1	.000	483.969	19.195	4.656	-.958
	79	1	.000	533.266	20.225	5.130	-1.387
	80	1	.000	492.113	19.745	4.309	-.464
	81	1	.000	461.844	18.600	4.547	-.209
	82	1	.000	552.912	20.209	5.640	-2.890
	83	1	.000	536.055	20.270	5.186	-.768
	84	1	.000	186.802	-3.211	2.110	.322
	85	1	.000	186.294	-2.365	2.413	.932
	86	1	.000	195.344	-2.606	2.731	.319
	87	1	.000	160.302	-3.136	.966	.742
	88	1	.000	154.860	-2.002	1.358	-.399
	89	1	.000	154.683	-2.392	1.019	1.224
	90	1	.000	203.494	-3.246	2.634	1.374
	91	1	.000	203.412	-.888	3.668	-.462
	92	1	.000	197.695	-2.318	2.969	-.166
	93	1	.000	153.961	-1.620	1.424	.445
	94	1	.000	165.424	-1.661	1.906	.328
	95	1	.000	177.405	-2.700	1.904	.915
	96	1	.000	167.738	-3.245	1.313	-1.255
	97	1	.000	132.758	-2.297	.055	1.101
	98	1	.000	170.392	-3.582	1.245	-.137
	99	1	.000	169.757	-3.730	1.138	-.370

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Second Highest Group			Discriminant Scores		
		Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Function 1	Function 2	Function 3
Original	100	1	.000	150.712	-2.965	.589	.989
	101	1	.000	170.497	-3.136	1.498	-.257
	102	1	.000	165.835	-3.920	.849	-.991
	103	1	.000	180.911	-3.687	1.555	.848
	104	1	.000	173.919	-3.343	1.462	.697
	105	1	.000	156.676	-2.105	1.354	.315
	106	1	.000	133.377	-2.681	-.038	.561
	107	1	.000	160.848	-3.299	.982	-.210
	108	1	.000	212.941	-3.065	3.054	1.578
	109	1	.000	153.614	-2.406	.963	1.228
	110	1	.000	179.842	-2.760	1.887	1.498
	111	1	.000	167.831	-2.831	1.501	.320
	112	1	.000	184.977	-3.172	1.879	1.613
	113	1	.000	152.722	-2.587	.758	1.624
	114	1	.000	150.180	-1.931	.910	1.800
	115	1	.000	159.192	-3.062	.805	1.627
	116	1	.000	192.068	-3.429	2.098	1.288
	117	1	.000	174.850	-3.438	1.417	.961
	118	1	.000	168.993	-2.832	1.402	1.429
	119	1	.000	166.792	-2.658	1.444	1.122
	120	1	.000	201.642	-2.526	2.799	1.857
	121	1	.000	196.693	-3.036	2.162	2.744
	122	1	.000	180.789	-3.134	1.806	1.128
	123	1	.000	194.888	-2.382	2.681	1.378
	124	1	.000	163.786	-2.941	1.230	.699
	125	1	.000	152.682	-1.978	1.184	.773
	126	1	.000	142.699	-2.381	.589	.371
	127	1	.000	168.812	-2.496	1.660	.727
	128	1	.000	174.726	-3.032	1.715	.078
	129	1	.000	170.764	-2.442	1.787	.554
	130	1	.000	190.306	-3.273	2.245	-.009
	131	1	.000	152.343	-2.966	.758	.110
	132	1	.000	207.976	-3.187	2.847	1.311

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Second Highest Group: Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Discriminant Scores: Function 1	Function 2	Function 3
Original	133	1	.000	179.933	-2.517	2.113	.749
	134	1	.000	188.539	-2.268	2.474	1.403
	135	1	.000	223.457	-2.307	3.887	.476
	136	2	.000	219.480	-3.073	3.748	.163
	137	2	.000	225.382	-3.297	4.866	.727
	138	1	.000	199.623	-2.774	2.863	-.581
	139	2	.000	177.255	-4.742	3.745	-.207
	140	1	.000	211.367	-2.937	3.208	.234
	141	1	.000	169.457	-2.815	1.537	.731
	142	1	.000	203.793	-3.524	2.541	1.168
	143	1	.000	186.000	-3.094	2.139	.271
	144	1	.000	173.038	-4.511	.621	1.285
	145	1	.000	156.081	-3.849	.205	1.553
	146	1	.000	157.157	-4.363	-.125	1.680
	147	1	.000	126.987	-2.211	-.152	.877
	148	1	.000	186.019	-5.194	.812	.792
	149	1	.000	195.830	-3.378	2.411	.060
	150	2	.000	195.326	-4.825	2.204	.622
	151	2	.000	200.487	-4.660	2.623	.798
	152	1	.000	201.660	-4.529	1.933	.862
	153	2	.000	169.827	-5.987	3.205	.562
	154	1	.000	227.712	-3.974	3.147	1.703
	155	2	.000	157.116	-5.959	1.208	-.604
	156	1	.000	195.386	-4.008	2.032	.404
	157	1	.000	186.014	-3.357	1.924	1.035
	158	1	.000	179.520	-4.683	.817	1.202
	159	2	.000	231.933	-4.077	4.313	1.857
	160	2	.000	236.777	-4.564	4.787	2.493
	161	1	.000	211.058	-2.660	3.063	2.063
	162	2	.000	181.497	-4.861	2.755	.039
	163	2	.000	189.923	-6.497	2.822	1.880
	164	1	.000	182.865	-4.028	1.296	1.700
	165	1	.000	191.718	-3.868	1.587	2.482

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Second Highest Group: Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Discriminant Scores: Function 1	Function 2	Function 3
Original	166	1	.000	195.296	-3.696	1.885	2.290
	167	1	.000	167.777	-4.178	.649	.991
	168	1	.000	162.975	-4.212	.517	-.100
	169	1	.000	189.535	-3.207	2.065	1.535
	170	1	.000	189.058	-4.576	1.453	-.056
	171	1	.000	192.650	-2.792	2.224	2.318
	172	1	.000	173.318	-2.999	1.554	1.147
	173	1	.000	121.984	-1.161	-.175	-3.412
	174	1	.000	121.808	-1.516	-.186	1.447
	175	1	.000	145.996	-2.248	.807	.362
	176	1	.000	165.933	-2.638	1.556	-.682
	177	1	.000	203.410	-2.718	2.933	.939
	178	1	.000	153.739	-3.144	.643	.865
	179	1	.000	174.263	-2.991	1.524	1.567
	180	1	.000	200.411	-3.035	2.513	1.918
	181	1	.000	176.311	-2.833	1.734	1.322
	182	1	.000	188.012	-2.382	2.376	1.570
	183	1	.000	179.295	-3.165	1.759	.900
	184	1	.000	162.858	-2.649	1.178	1.658
	185	1	.000	179.536	-3.221	1.659	1.424
	186	1	.000	151.856	-3.256	.492	.862
	187	1	.000	198.455	-4.567	1.806	.608
	188	1	.000	217.767	-4.700	2.300	1.960
	189	2	.000	190.992	-5.288	2.304	.864
	190	2	.000	188.393	-4.810	2.397	.289
	191	1	.000	221.931	-4.074	2.930	1.377
	192	1	.000	77.551	-1.085	-4.067	4.386
	193	1	.000	149.483	-2.502	.858	.195
	194	1	.000	179.721	-2.738	2.023	.572
	195	1	.000	154.567	-1.942	1.349	.090
	196	1	.000	180.767	-2.445	1.808	2.636
	197	1	.000	180.140	-2.363	2.155	1.009
	198	1	.000	152.572	-2.948	.794	-.134

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Second Highest Group: Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Discriminant Scores: Function 1	Function 2	Function 3
Original	199	1	.000	144.976	-2.386	.711	.171
	200	1	.000	143.875	-2.856	.366	.656
	201	1	.000	166.003	-3.033	1.240	1.003
	202	1	.000	177.699	-2.910	1.882	.322
	203	1	.000	152.412	-2.838	.833	.051
	204	1	.000	162.952	-2.916	1.246	.321
	205	1	.000	166.467	-2.962	1.320	.838
	206	1	.000	161.105	-2.367	1.445	.124
	207	1	.000	171.590	-1.961	1.998	.792
	208	1	.000	162.078	-2.295	1.481	.562
	209	1	.000	169.075	-2.791	1.492	1.026
	210	1	.000	154.873	-3.228	.618	1.067
	211	1	.000	160.976	-2.498	1.270	1.096
	212	1	.000	156.890	-3.011	.727	1.630
	213	1	.000	136.845	-2.505	.125	1.226
	214	1	.000	175.308	-3.469	1.426	.912
	215	1	.000	192.227	-2.504	2.513	1.451
	216	1	.000	175.407	-3.057	1.675	.693
	217	1	.000	180.294	-3.381	1.688	.872
	218	1	.000	172.457	-3.186	1.449	.954
	219	1	.000	158.749	-3.073	.747	1.773
	220	1	.000	165.015	-2.785	1.213	1.626
	221	1	.000	167.569	-3.081	1.187	1.558
	222	1	.000	186.804	-3.613	1.677	1.839
	223	1	.000	158.273	-3.923	.245	1.632
	224	1	.000	174.097	-3.907	.838	2.283
	225	1	.000	145.294	-4.197	-.460	.947
	226	1	.000	166.562	-3.751	.899	.730
	227	1	.000	162.192	-3.315	.892	1.152
	228	1	.000	162.930	-3.655	.732	1.127
	229	1	.000	177.921	-3.358	1.620	.745
	230	1	.000	181.794	-3.427	1.866	1.310
	231	1	.000	181.016	-2.922	1.786	1.862

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Second Highest Group: Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Discriminant Scores: Function 1	Function 2	Function 3
Original	232	1	.000	156.481	-3.035	.650	1.831
	233	1	.000	177.057	-3.489	1.314	1.891
	234	1	.000	182.559	-3.804	1.515	1.152
	235	1	.000	180.552	-3.246	1.751	1.044
	236	1	.000	158.066	-3.141	.882	.579
	237	1	.000	181.013	-2.667	2.080	.831
	238	1	.000	150.860	-3.504	.299	.849
	239	1	.000	152.206	-2.854	.835	-.351
	240	1	.000	161.432	-2.130	1.518	.633
	241	1	.000	138.487	-2.855	.167	.044
	242	1	.000	171.521	-2.575	1.720	.876
	243	1	.000	161.367	-3.185	1.027	.387
	244	1	.000	211.922	-2.961	3.095	1.346
	245	1	.000	161.096	-3.050	1.068	.572
	246	1	.000	161.616	-3.369	.872	.919
	247	1	.000	180.156	-3.098	1.749	1.423
	249	1	.000	448.413	18.222	4.497	-.681
	250	4	.000	527.138	19.077	6.415	-2.194
	251	1	.000	546.750	19.311	6.277	-3.614
	252	1	.000	566.918	20.112	6.313	-1.468
	253	1	.000	480.812	18.860	4.748	-2.918
	254	1	.000	550.653	21.382	4.146	-2.994
	255	1	.000	556.005	21.190	4.757	-.517
	256	1	.000	509.526	19.971	4.407	-3.318
	257	1	.000	641.569	22.108	6.379	-1.236
	258	1	.000	530.676	20.270	5.002	-1.124
	260	4	.000	132.475	1.335	-8.977	.045
	261	4	.000	154.913	2.929	-9.189	-.434
	262	4	.000	152.014	1.683	-9.723	.062
	263	4	.000	200.963	3.515	-10.916	.501
	264	4	.000	175.326	.419	-10.966	3.120
	265	4	.000	210.384	3.033	-11.314	-1.483
	266	4	.000	182.045	3.000	-10.265	-1.031

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

		Second Highest Group			Discriminant Scores		
	Case Number	Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Function 1	Function 2	Function 3
Original	267	4	.000	189.976	2.412	-10.820	-1.353
	268	4	.000	162.143	2.400	-9.764	-.869
	269	4	.000	152.989	3.027	-9.124	.697
	271	1	.000	179.273	-5.308	.262	1.611
	272	2	.000	189.164	-6.863	2.438	2.046
	273	2	.000	177.988	-6.485	.704	.802
	274	1	.000	219.115	-4.169	2.422	2.932
	275	1	.000	194.460	-5.388	.938	1.483
	276	1	.000	196.871	-2.193	2.968	.185
	277	1	.000	192.623	-2.277	2.740	.570
	278	1	.000	182.197	-2.896	1.946	1.351
	279	2	.000	183.024	-6.069	.229	.528
	280	2	.000	234.607	-3.093	4.087	.971

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

		Second Highest Group			Discriminant Scores		
	Case Number	Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Function 1	Function 2	Function 3
Cross-validated[a]	1	4	.000	206.009			
	2	4	.000	191.004			
	3	4	.000	197.223			
	4	4	.000	189.687			
	5	4	.000	203.234			
	6	4	.000	179.753			
	7	4	.000	191.558			
	8	4	.000	182.752			
	9	4	.000	188.571			
	10	4	.000	159.397			
	11	4	.000	219.689			
	12	4	.000	244.634			
	13	4	.000	178.088			
	14	4	.000	159.631			
	15	4	.000	165.582			
	16	4	.000	174.615			
	17	4	.000	199.694			
	18	4	.000	232.232			
	19	4	.000	190.554			
	20	4	.000	169.416			
	21	4	.000	178.126			
	22	4	.000	255.372			
	23	4	.000	186.670			
	24	4	.000	195.422			
	25	4	.000	177.421			
	26	4	.000	208.274			
	27	4	.000	186.897			
	28	4	.000	168.221			
	29	4	.000	200.394			
	30	4	.000	162.035			
	31	4	.000	195.654			
	32	4	.000	165.650			
	33	4	.000	156.917			

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Second Highest Group: Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Discriminant Scores: Function 1	Function 2	Function 3
Cross-validated[a]	34	4	.000	482.732			
	35	4	.000	294.471			
	36	4	.000	295.969			
	37	4	.000	189.587			
	38	4	.000	176.907			
	39	4	.000	227.409			
	40	4	.000	216.290			
	41	4	.000	214.070			
	42	4	.000	260.682			
	67	1	.000	509.759			
	68	1	.000	560.484			
	69	1	.000	455.130			
	70	1	.000	445.420			
	71	1	.000	387.543			
	72	1	.000	403.184			
	73	1	.000	449.979			
	74	1	.000	603.613			
	75	1	.000	487.815			
	76	4	.000	557.630			
	77	4	.000	535.688			
	78	1	.000	494.439			
	79	1	.000	553.884			
	80	1	.000	503.469			
	81	1	.000	470.699			
	82	1	.000	573.958			
	83	1	.000	543.130			
	84	1	.000	196.312			
	85	1	.000	201.600			
	86	1	.000	210.409			
	87	1	.000	168.930			
	88	1	.000	162.655			
	89	1	.000	162.850			
	90	1	.000	218.872			

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

	Case Number	Second Highest Group: Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Discriminant Scores: Function 1	Function 2	Function 3
Cross-validated[a]	91	1	.000	239.012			
	92	1	.000	229.567			
	93	1	.000	166.364			
	94	1	.000	184.170			
	95	1	.000	184.767			
	96	1	.000	184.591			
	97	1	.000	153.349			
	98	1	.000	174.900			
	99	1	.000	175.612			
	100	1	.000	157.733			
	101	1	.000	173.110			
	102	1	.000	175.969			
	103	1	.000	188.325			
	104	1	.000	177.681			
	105	1	.000	164.575			
	106	1	.000	140.452			
	107	1	.000	166.034			
	108	1	.000	224.978			
	109	1	.000	164.667			
	110	1	.000	185.066			
	111	1	.000	174.273			
	112	1	.000	191.549			
	113	1	.000	161.728			
	114	1	.000	156.036			
	115	1	.000	164.840			
	116	1	.000	200.418			
	117	1	.000	184.081			
	118	1	.000	176.848			
	119	1	.000	170.060			
	120	1	.000	222.345			
	121	1	.000	224.081			
	122	1	.000	195.739			
	123	1	.000	209.365			

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

		Second Highest Group			Discriminant Scores		
	Case Number	Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Function 1	Function 2	Function 3
Cross-validated[a]	124	1	.000	176.783			
	125	1	.000	161.909			
	126	1	.000	152.163			
	127	1	.000	172.401			
	128	1	.000	181.764			
	129	1	.000	178.405			
	130	1	.000	199.449			
	131	1	.000	156.369			
	132	1	.000	221.556			
	133	1	.000	191.992			
	134	1	.000	197.962			
	135	1	.000	231.934			
	136	2	.000	238.287			
	137	2	.000	244.902			
	138	1	.000	219.796			
	139	2	.000	194.090			
	140	1	.000	222.546			
	141	1	.000	188.415			
	142	1	.000	221.433			
	143	1	.000	202.916			
	144	1	.000	179.333			
	145	1	.000	164.529			
	146	1	.000	164.431			
	147	1	.000	139.000			
	148	1	.000	198.757			
	149	1	.000	207.288			
	150	2	.000	201.953			
	151	2	.000	204.796			
	152	1	.000	211.044			
	153	2	.000	183.027			
	154	2	.000	240.968			
	155	2	.000	172.736			
	156	1	.000	198.675			

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

		Second Highest Group			Discriminant Scores		
	Case Number	Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Function 1	Function 2	Function 3
Cross-validated[a]	157	1	.000	193.278			
	158	1	.000	214.949			
	159	2	.000	237.368			
	160	2	.000	240.561			
	161	1	.000	225.831			
	162	2	.000	185.902			
	163	2	.000	198.696			
	164	1	.000	187.725			
	165	1	.000	203.002			
	166	1	.000	206.454			
	167	1	.000	178.819			
	168	1	.000	193.736			
	169	1	.000	200.708			
	170	1	.000	202.913			
	171	1	.000	225.663			
	172	1	.000	189.848			
	173	1	.000	160.766			
	174	1	.000	130.710			
	175	1	.000	151.437			
	176	1	.000	171.744			
	177	1	.000	214.901			
	178	1	.000	159.109			
	179	1	.000	186.401			
	180	1	.000	214.277			
	181	1	.000	185.666			
	182	1	.000	198.185			
	183	1	.000	195.650			
	184	1	.000	172.884			
	185	1	.000	194.124			
	186	1	.000	166.270			
	187	1	.000	212.609			
	188	1	.000	245.661			
	189	2	.000	208.297			

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

Casewise Statistics

		Second Highest Group			Discriminant Scores		
	Case Number	Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Function 1	Function 2	Function 3
Cross-validated[a]	190	2	.000	198.083			
	191	2	.000	228.390			
	192	4	.000	662.636			
	193	1	.000	155.402			
	194	1	.000	196.804			
	195	1	.000	161.980			
	196	1	.000	189.630			
	197	1	.000	185.204			
	198	1	.000	155.088			
	199	1	.000	150.566			
	200	1	.000	148.812			
	201	1	.000	169.704			
	202	1	.000	183.462			
	203	1	.000	162.395			
	204	1	.000	165.716			
	205	1	.000	179.426			
	206	1	.000	165.308			
	207	1	.000	176.695			
	208	1	.000	165.010			
	209	1	.000	178.659			
	210	1	.000	164.649			
	211	1	.000	165.610			
	212	1	.000	169.166			
	213	1	.000	143.231			
	214	1	.000	179.194			
	215	1	.000	199.649			
	216	1	.000	182.125			
	217	1	.000	191.403			
	218	1	.000	178.690			
	219	1	.000	162.464			
	220	1	.000	167.728			
	221	1	.000	179.465			
	222	1	.000	194.829			

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

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Casewise Statistics

		Second Highest Group			Discriminant Scores		
	Case Number	Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Function 1	Function 2	Function 3
Cross-validated[a]	223	1	.000	163.949			
	224	1	.000	177.874			
	225	1	.000	148.242			
	226	1	.000	175.683			
	227	1	.000	165.843			
	228	1	.000	168.461			
	229	1	.000	183.518			
	230	1	.000	183.579			
	231	1	.000	183.377			
	232	1	.000	161.279			
	233	1	.000	183.507			
	234	1	.000	191.624			
	235	1	.000	183.862			
	236	1	.000	160.425			
	237	1	.000	184.980			
	238	1	.000	157.816			
	239	1	.000	156.977			
	240	1	.000	167.163			
	241	1	.000	145.946			
	242	1	.000	175.332			
	243	1	.000	165.464			
	244	1	.000	219.038			
	245	1	.000	165.607			
	246	1	.000	164.745			
	247	1	.000	187.411			
	249	1	.000	467.979			
	250	4	.000	544.705			
	251	4	.000	667.599			
	252	4	.000	580.574			
	253	1	.000	506.791			
	254	1	.000	687.163			
	255	1	.000	606.768			
	256	1	.000	620.475			

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

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Casewise Statistics

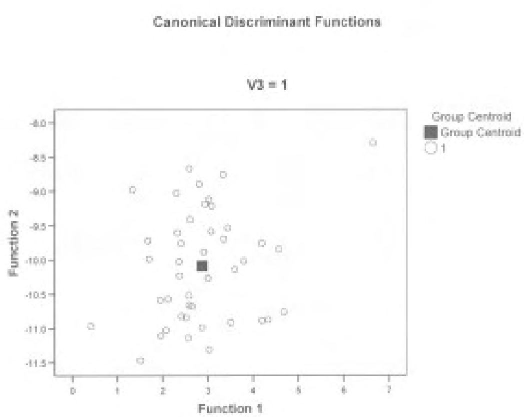
	Case Number	Second Highest Group			Discriminant Scores		
		Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Function 1	Function 2	Function 3
Cross-validated[a]	257	1	.000	691.134			
	258	1	.000	549.384			
	260	4	.000	142.630			
	261	4	.000	163.030			
	262	4	.000	159.356			
	263	4	.000	243.049			
	264	4	.000	309.855			
	265	4	.000	234.357			
	266	4	.000	196.696			
	267	4	.000	201.208			
	268	4	.000	177.227			
	269	4	.000	157.474			

For the original data, squared Mahalanobis distance is based on canonical functions.
For the cross-validated data, squared Mahalanobis distance is based on observations.

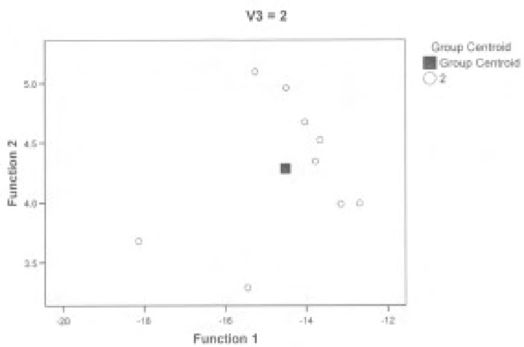
**. Misclassified case

a. Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case.

Separate-Groups Graphs



Canonical Discriminant Functions



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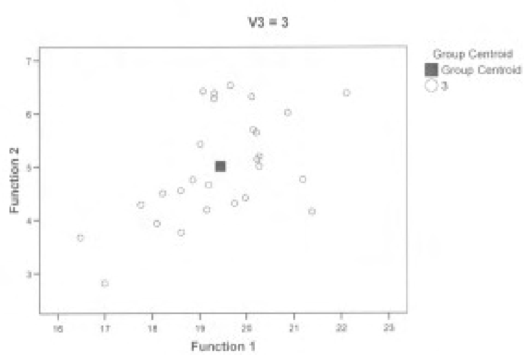
Canonical Discriminant Functions



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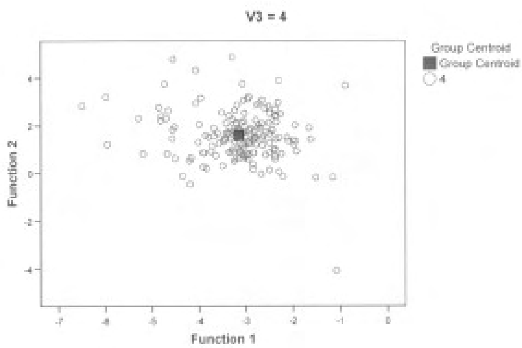
Canonical Discriminant Functions



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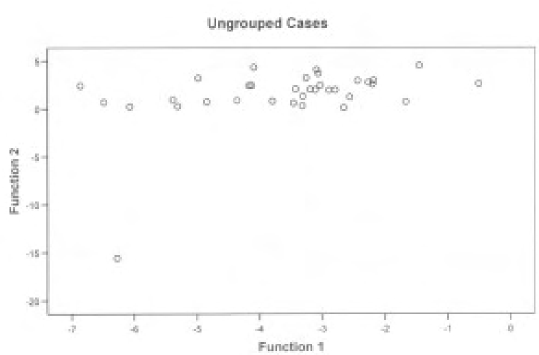
Canonical Discriminant Functions



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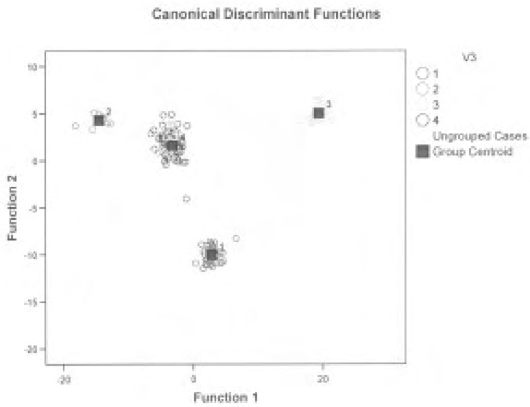


Classification Results[b,c]

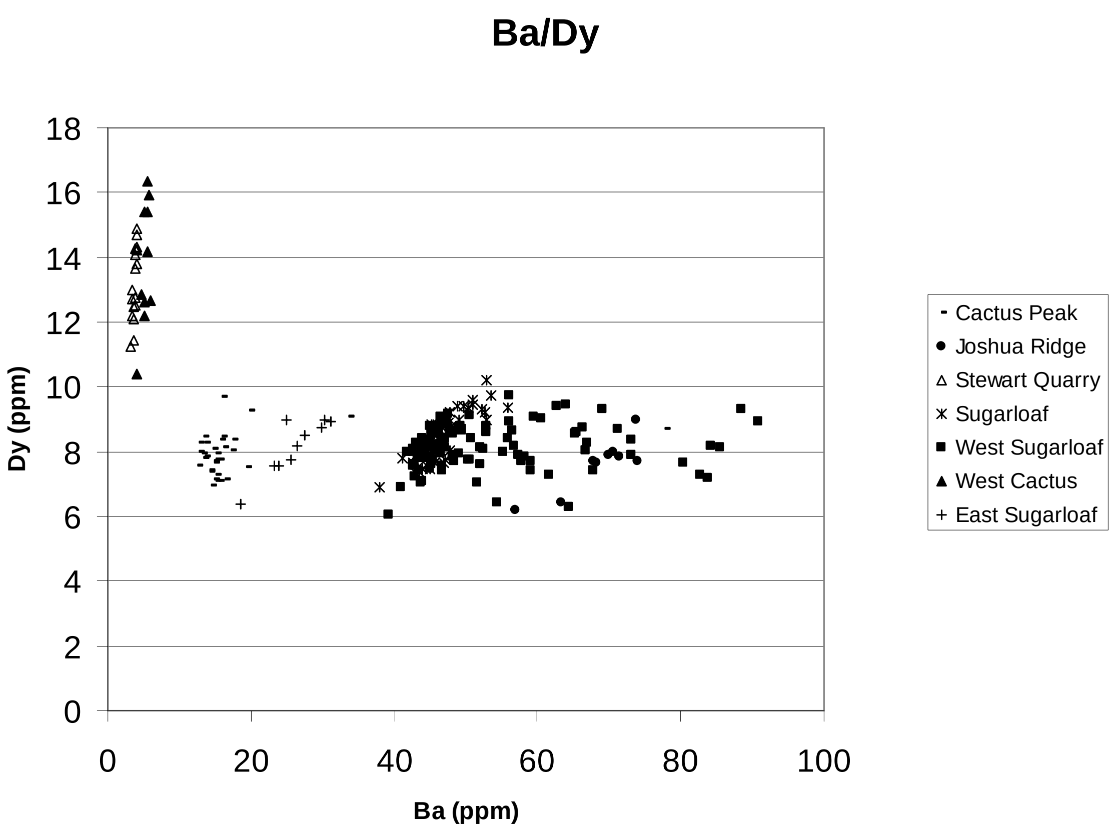
		V3	Predicted Group Membership 1.00	2.00	3.00	4.00	Total
Original	Count	1.00	43	0	0	0	43
		2.00	0	9	0	0	9
		3.00	0	0	27	0	27
		4.00	0	0	0	164	164
		Ungrouped cases	1	0	0	33	34
	%	1.00	100.0	.0	.0	.0	100.0
		2.00	.0	100.0	.0	.0	100.0
		3.00	.0	.0	100.0	.0	100.0
		4.00	.0	.0	.0	100.0	100.0
		Ungrouped cases	2.9	.0	.0	97.1	100.0
Cross-validated[a]	Count	1.00	43	0	0	0	43
		2.00	0	9	0	0	9
		3.00	0	0	27	0	27
		4.00	1	0	0	163	164
	%	1.00	100.0	.0	.0	.0	100.0
		2.00	.0	100.0	.0	.0	100.0
		3.00	.0	.0	100.0	.0	100.0
		4.00	.6	.0	.0	99.4	100.0

a. Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case.

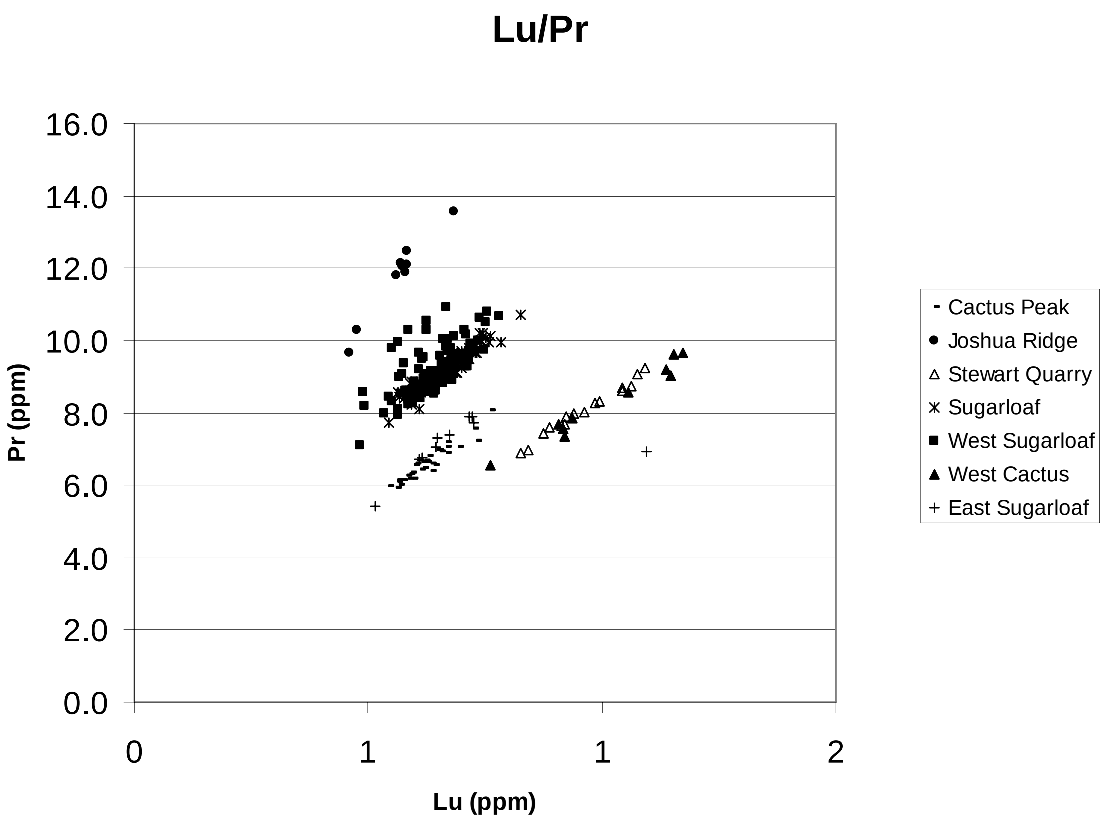
b. 100.0% of original grouped cases correctly classified.

c. 99.6% of cross-validated grouped cases correctly classified.

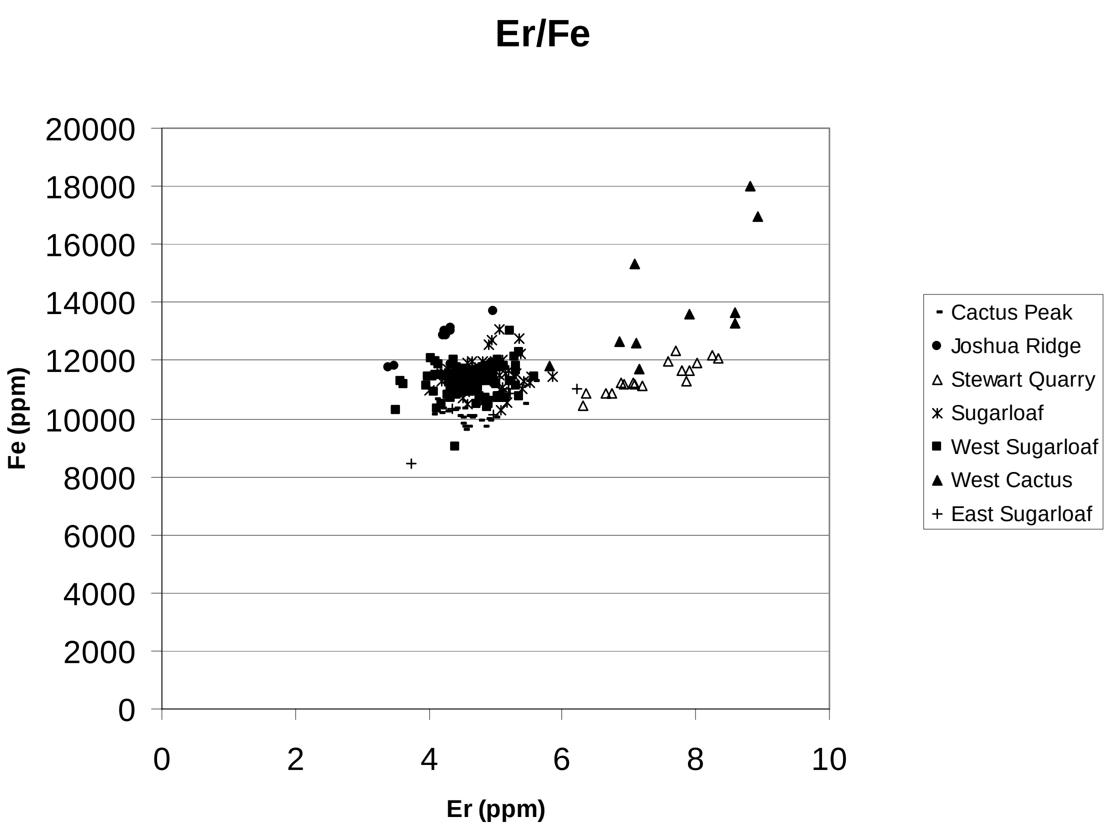
Appendix G: Additional bivariate plots for Laser Ablation results



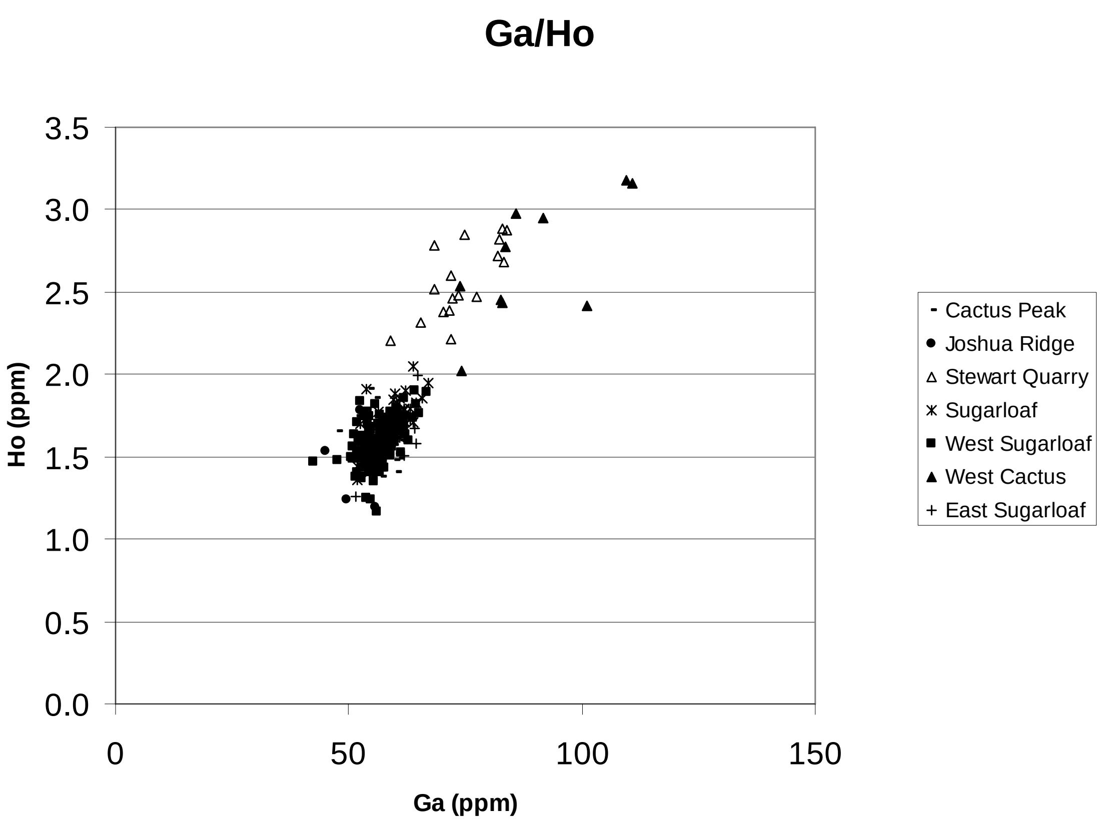
Appendix G cont.: Additional bivariate plots for Laser Ablation results



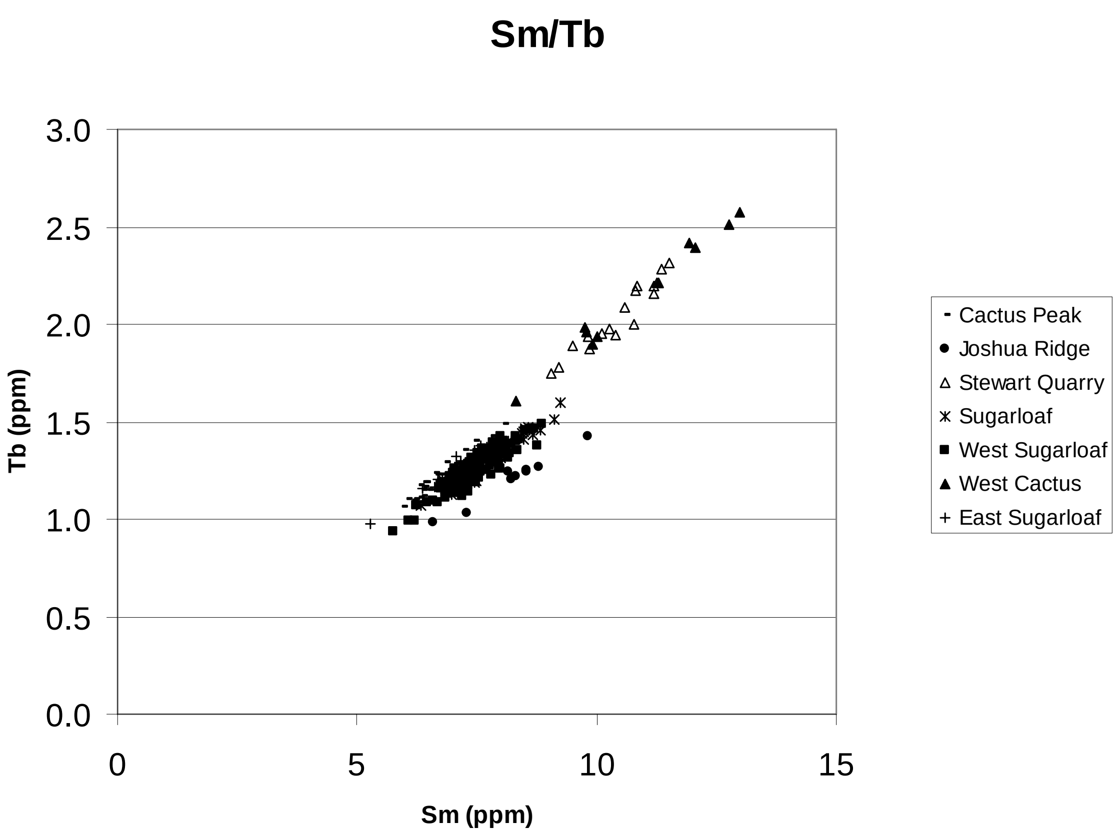
Appendix G cont.: Additional bivariate plots for Laser Ablation results



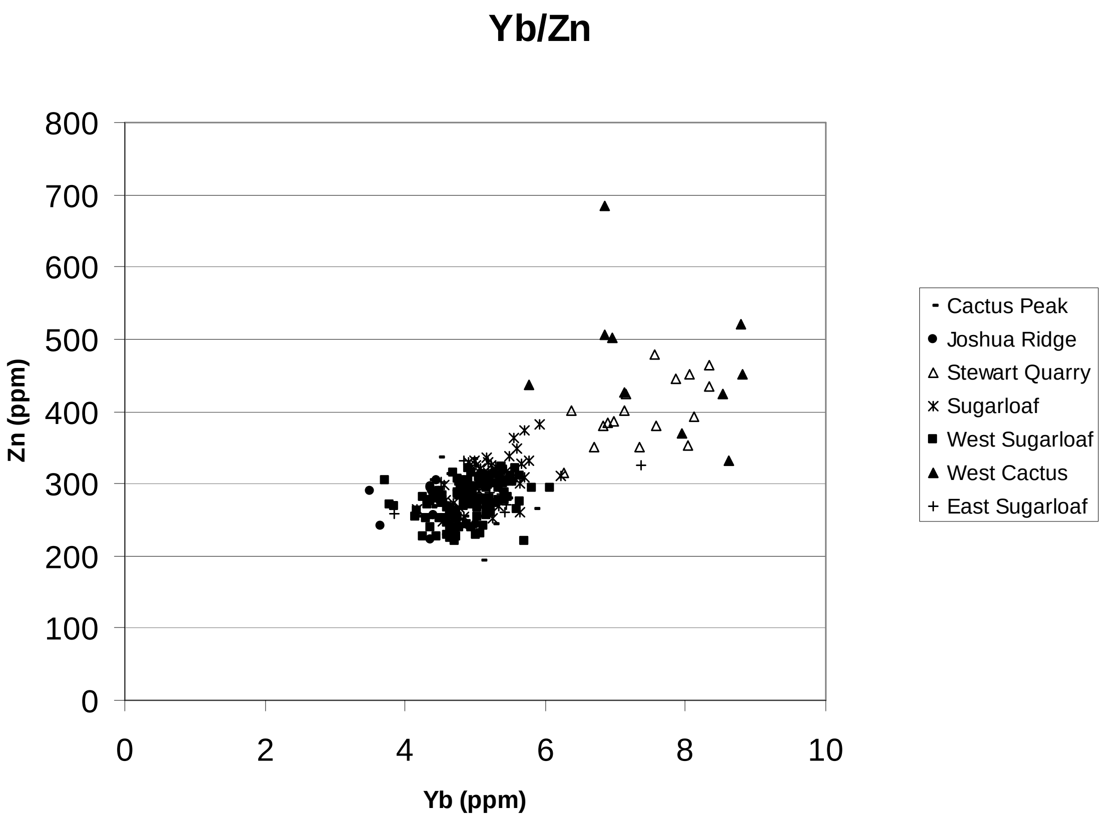
Appendix G cont.: Additional bivariate plots for Laser Ablation results



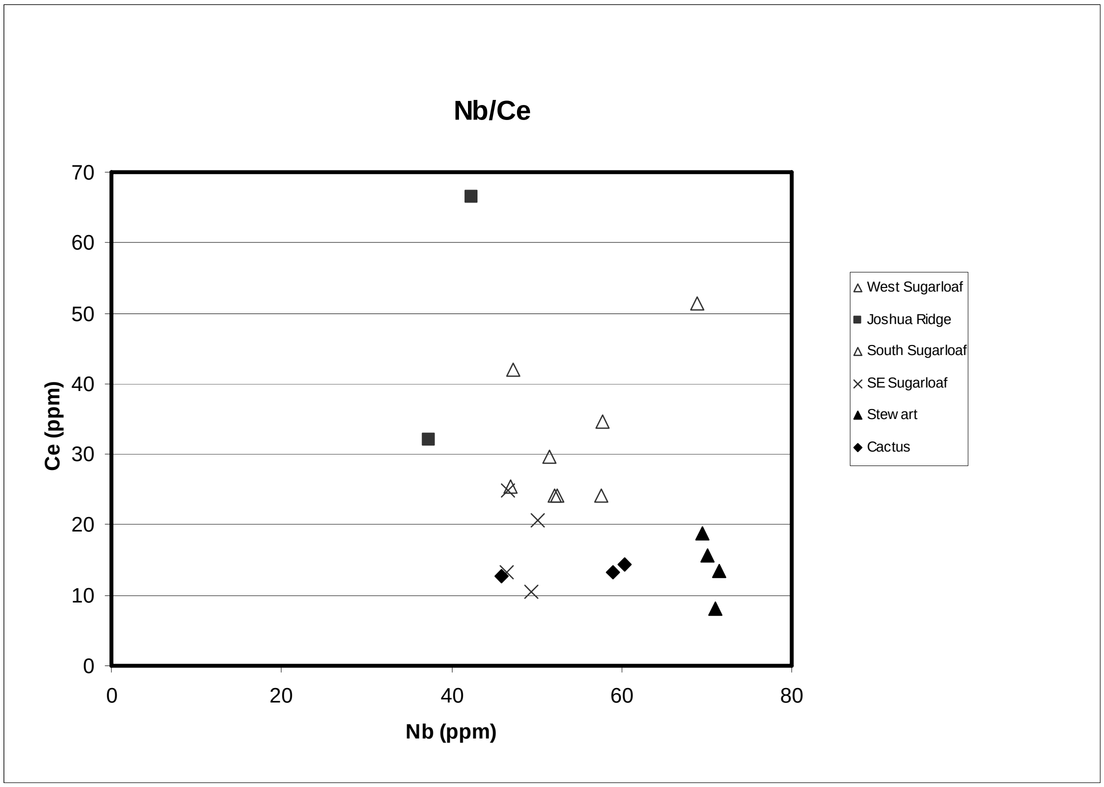
Appendix G cont.: Additional bivariate plots for Laser Ablation results



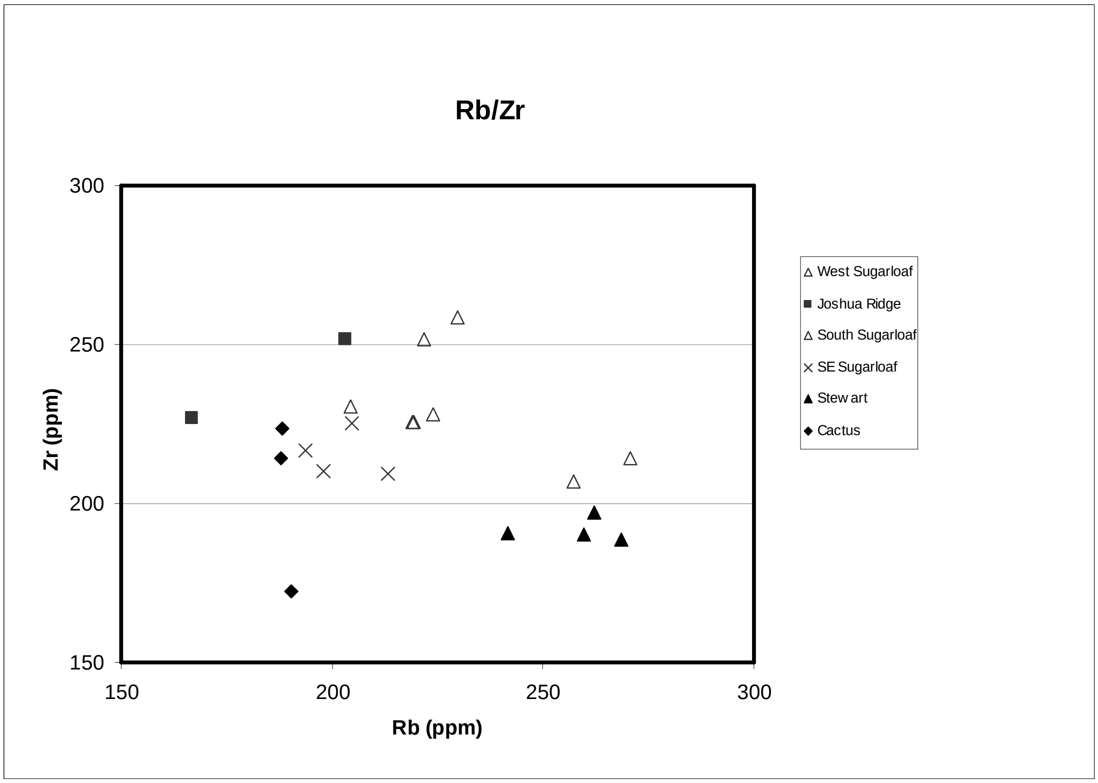
Appendix G cont.: Additional bivariate plots for Laser Ablation results



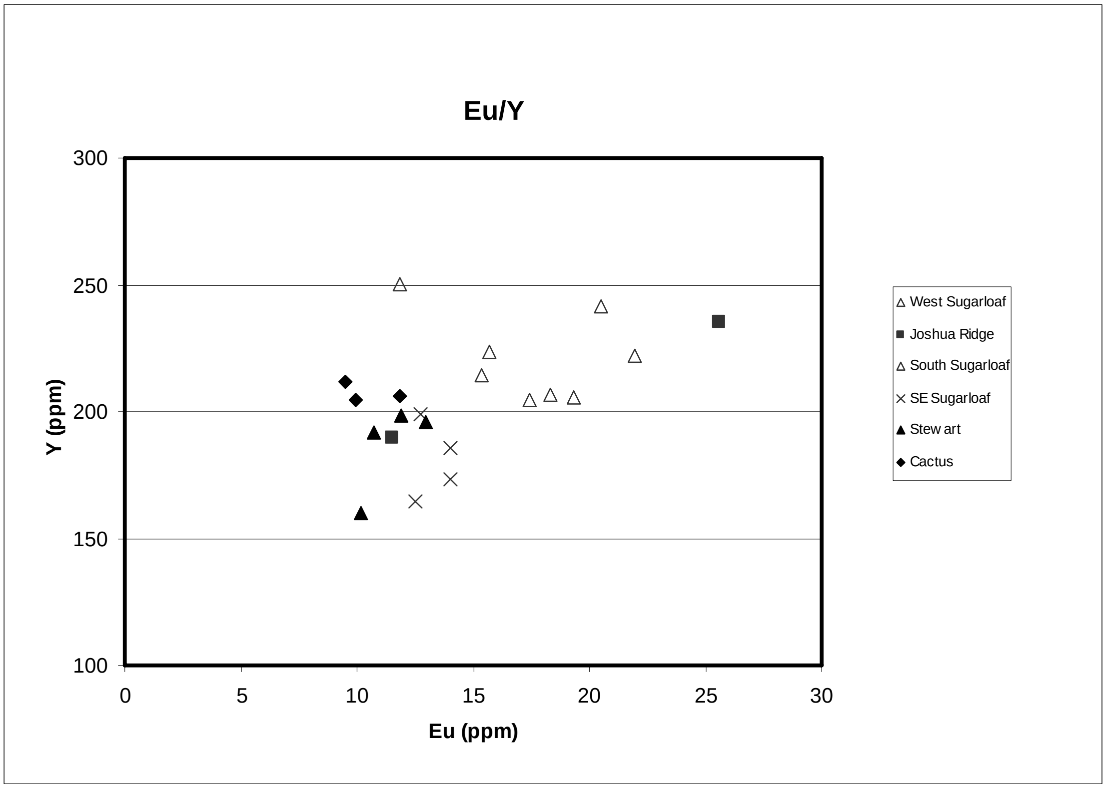
Appendix H: Additional bivariate plots for ICP-MS from Microwave Digestion results



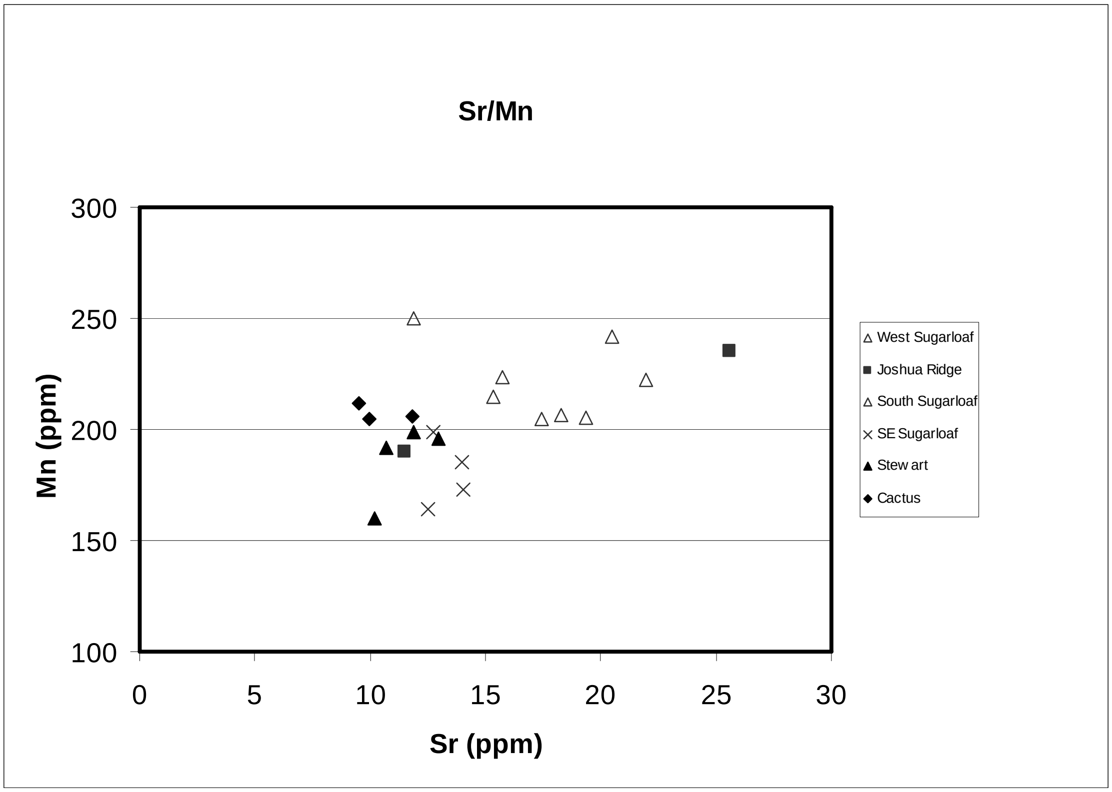
Appendix H cont.: Additional bivariate plots for ICP-MS from Microwave Digestion results



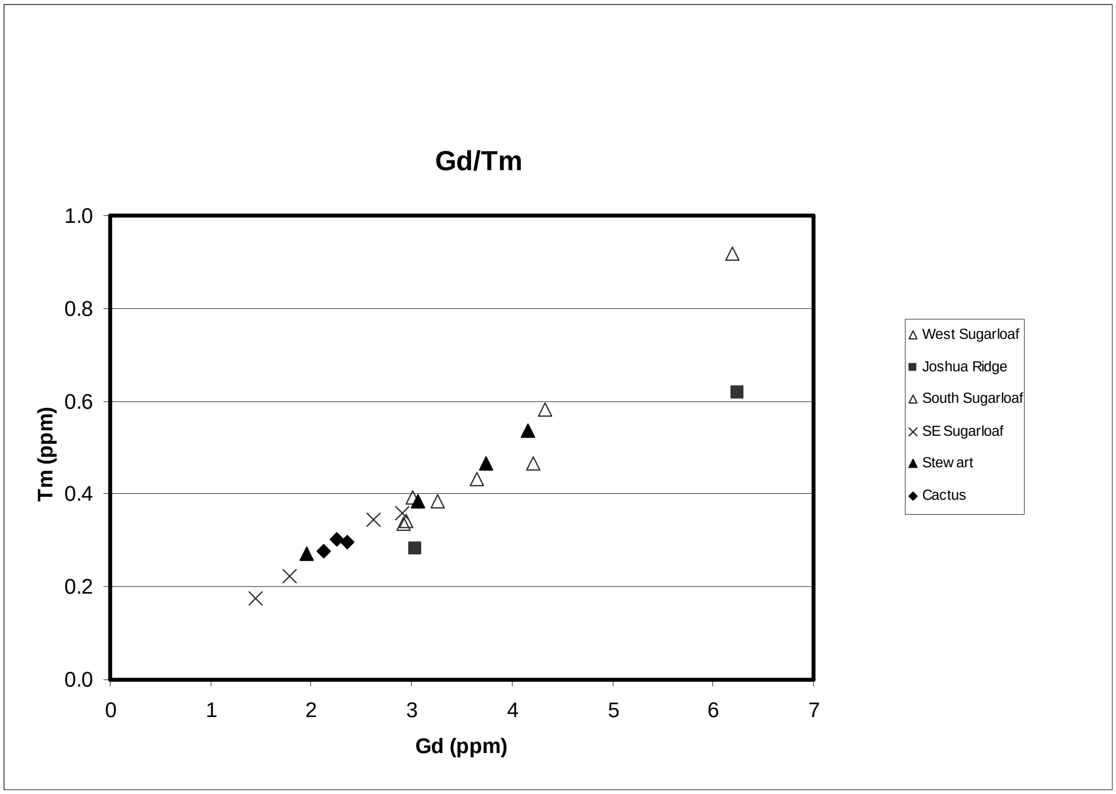
Appendix H cont.: Additional bivariate plots for ICP-MS from Microwave Digestion results



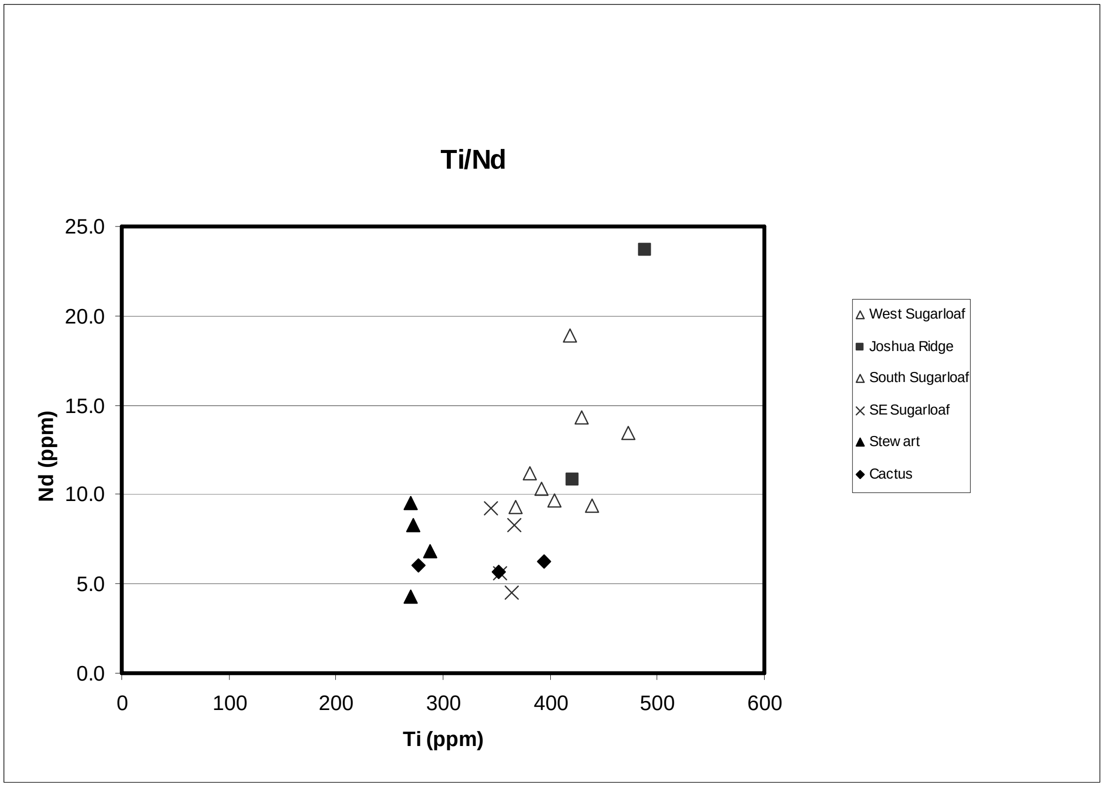
Appendix H cont.: Additional bivariate plots for ICP-MS from Microwave Digestion results



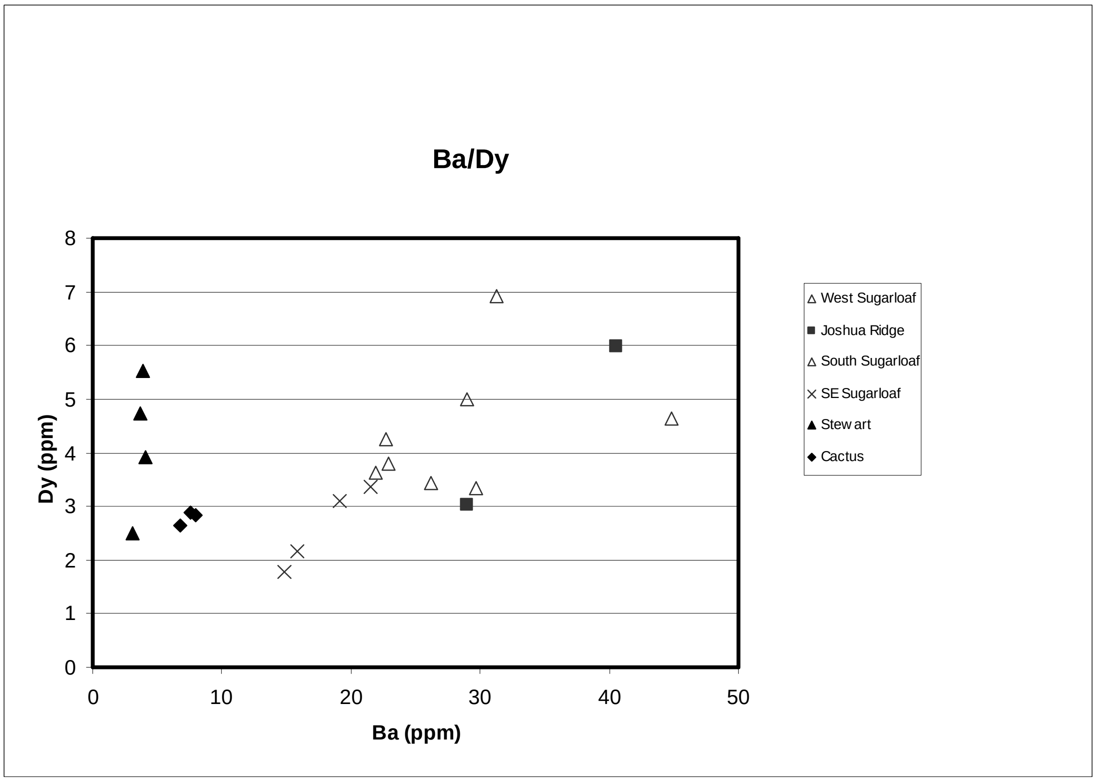
Appendix H cont.: Additional bivariate plots for ICP-MS from Microwave Digestion results



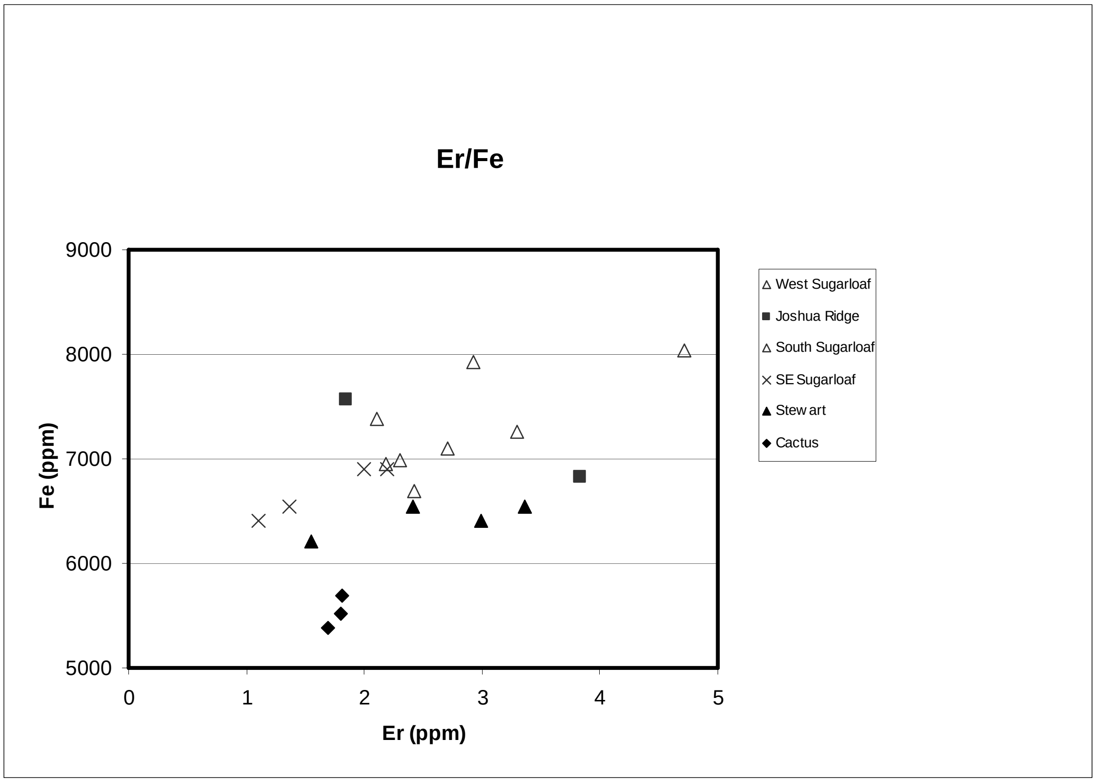
Appendix H cont.: Additional bivariate plots for ICP-MS from Microwave Digestion results



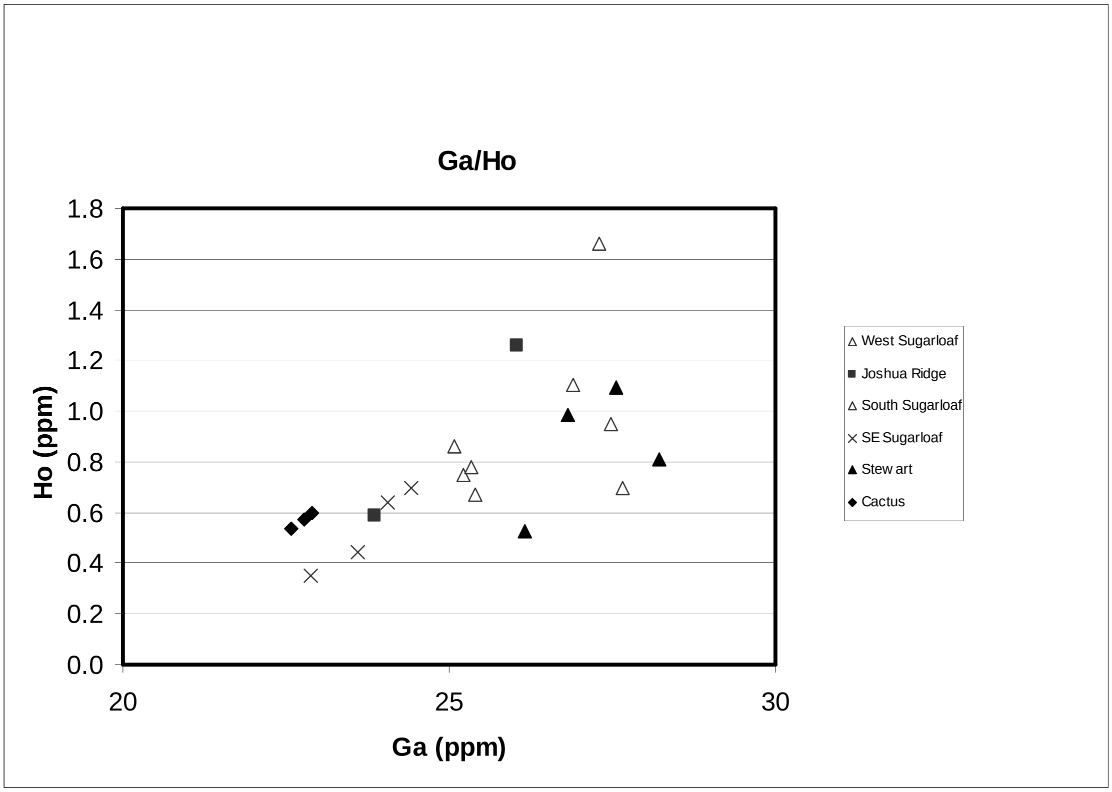
Appendix H cont.: Additional bivariate plots for ICP-MS from Microwave Digestion results



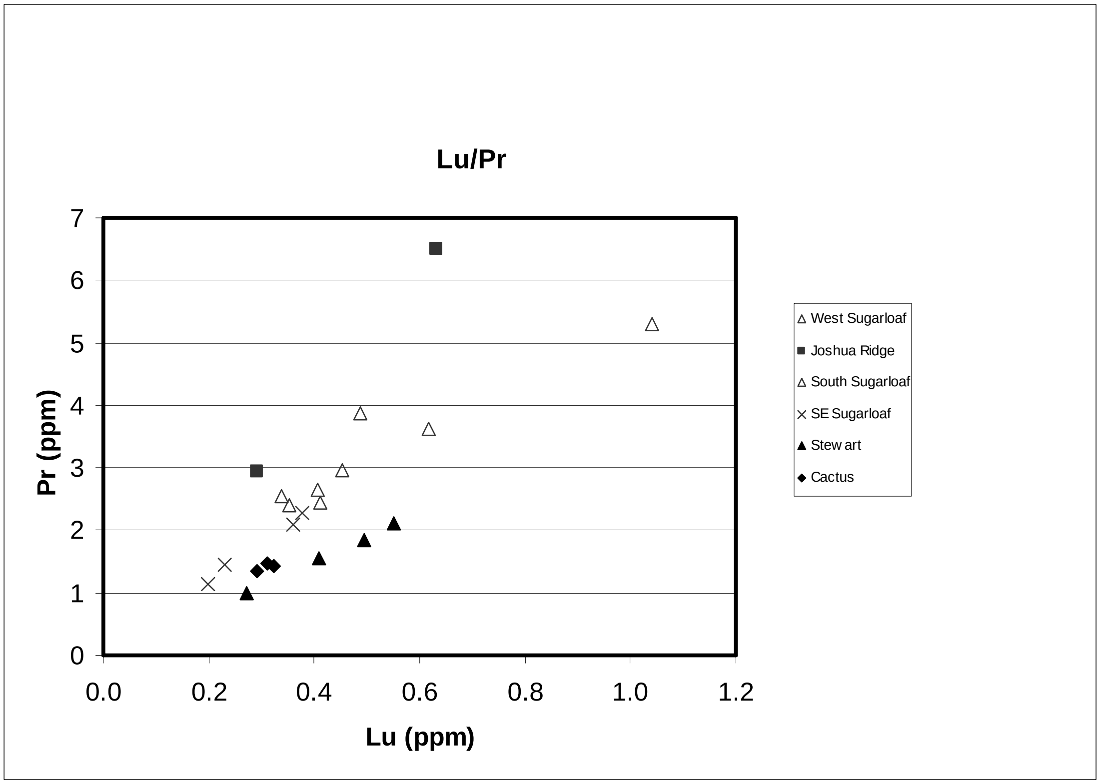
Appendix H cont.: Additional bivariate plots for ICP-MS from Microwave Digestion results



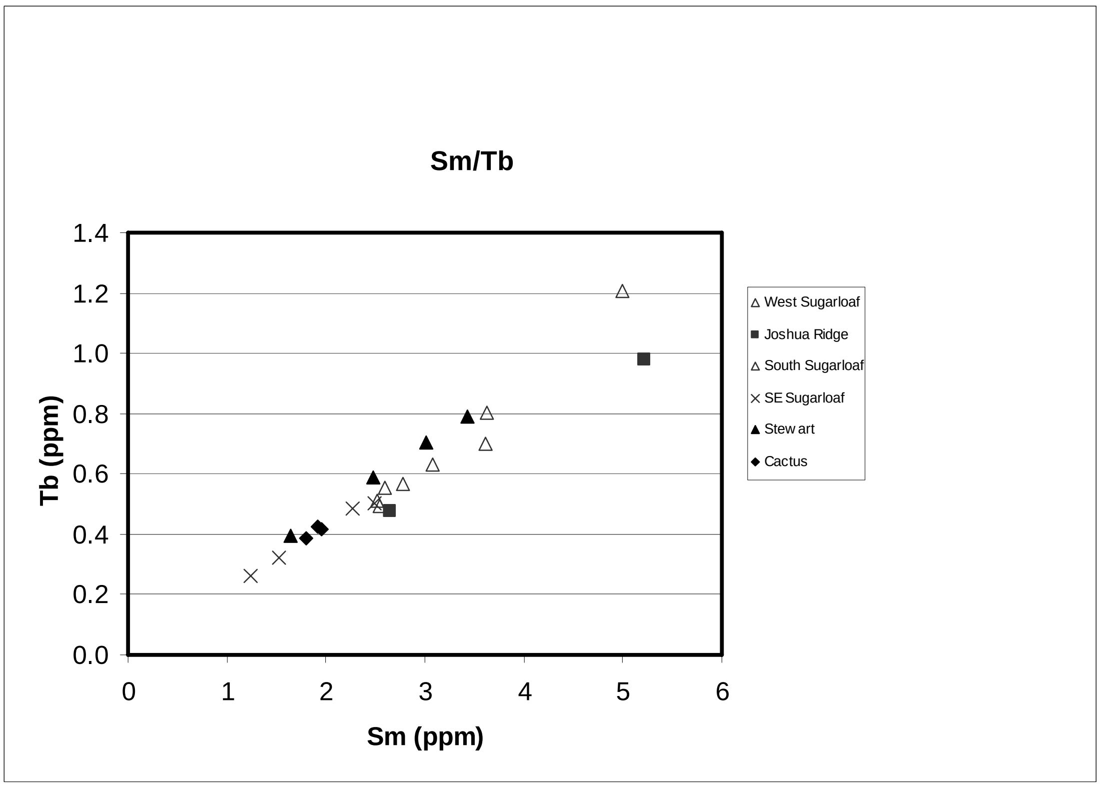
Appendix H cont.: Additional bivariate plots for ICP-MS from Microwave Digestion results



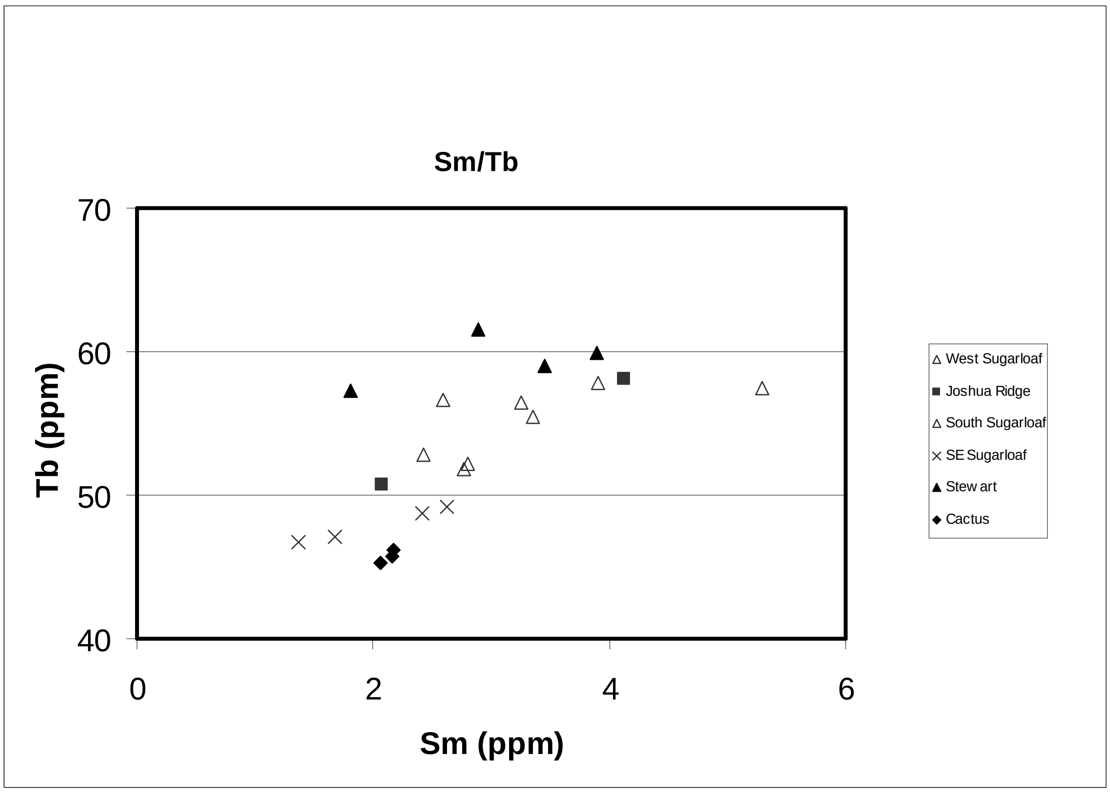
Appendix H cont.: Additional bivariate plots for ICP-MS from Microwave Digestion results



Appendix H cont.: Additional bivariate plots for ICP-MS from Microwave Digestion results



Appendix H cont.: Additional bivariate plots for ICP-MS from Microwave Digestion results



Appendix I: Individual Sample Data from Laser Ablation Analysis.

Element	Cactus1_A	Cactus1_B	Cactus1_C	Cactus1_D	Cactus1_E	Cactus1_F	Cactus1_G	Cactus1_H	Cactus1_I	Cactus1_J	Cactus1_K	Cactus1_L	Cactus1_M	Cactus2_A	Cactus2_B
Ba	17.4	19.5	14.9	15.5	15.2	14.9	15.1	14.2	16.4	14.6	15.0	19.7	15.5	33.7	12.9
Ce	72.2	65.9	65.5	62.1	62.7	64.3	63.4	64.7	63.4	62.4	63.3	70.4	67.3	78.0	71.9
Dy	8.4	7.5	7.7	7.1	7.1	7.1	7.3	7.4	7.1	7.0	7.7	9.3	7.8	9.1	8.3
Er	4.8	4.3	4.4	4.1	4.1	4.1	4.1	4.2	4.2	4.0	4.5	5.4	4.5	5.1	4.7
Eu	0.09	0.08	0.08	0.07	0.08	0.07	0.08	0.08	0.08	0.07	0.08	0.10	0.08	0.09	0.08
Fe	10377	10294	10321	10259	10326	10637	10422	10361	10182	10147	9798	10507	10336	11739	11295
Ga	47.7	54.2	55.2	60.2	57.0	56.6	56.5	56.1	54.2	52.5	54.0	54.7	51.0	55.8	61.6
Gd	7.1	6.4	6.6	6.1	6.0	6.1	6.1	6.2	6.0	6.0	6.5	7.9	6.6	7.7	7.2
Ho	1.66	1.46	1.50	1.41	1.38	1.42	1.42	1.43	1.40	1.40	1.53	1.81	1.51	1.85	1.63
Lu	0.67	0.59	0.61	0.57	0.56	0.56	0.57	0.58	0.56	0.54	0.60	0.73	0.60	0.73	0.65
Mn	593	565	566	550	559	579	571	569	562	550	542	581	576	661	619
Nb	108	104	101	99	98	102	99	100	101	100	101	108	105	110	108
Nd	25.9	23.7	24.2	22.2	22.1	22.9	22.7	23.1	22.2	21.7	23.1	27.8	24.0	28.3	26.3
Pr	7.2	6.4	6.4	6.0	5.9	6.1	6.1	6.3	6.1	6.0	6.2	7.2	6.6	7.6	7.0
Rb	232	262	269	281	263	264	269	258	258	259	261	263	256	249	272
Sm	7.2	6.4	6.4	6.2	6.3	6.0	6.3	6.4	6.2	5.9	6.4	7.8	7.0	7.4	7.0
Sr	4.9	4.4	4.3	4.5	4.4	4.2	4.2	4.1	4.3	4.0	4.2	5.5	4.4	5.5	4.0
Tb	1.3	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.4	1.2	1.4	1.3
Ti	661	620	601	581	594	596	588	594	599	591	591	662	626	636	585
Tm	0.75	0.66	0.69	0.63	0.63	0.63	0.64	0.65	0.64	0.62	0.68	0.84	0.67	0.80	0.73
Y	34.0	30.6	31.2	29.2	28.5	29.2	29.5	29.7	28.8	28.1	30.5	37.1	30.8	36.3	32.8
Yb	5.1	4.5	4.7	4.4	4.4	4.4	4.4	4.5	4.3	4.2	4.6	5.6	4.6	5.5	5.0
Zn	193	230	245	282	257	267	270	273	253	255	265	272	237	280	333
Zr	296	264	270	246	249	250	250	257	250	249	263	322	271	307	282

Element	Cactus2_C	Cactus2_D	Cactus2_E	Cactus2_F	Cactus2_G	Cactus2_H	Cactus2_T	Cactus2_U	Joshua Ridge_A	Joshua Ridge_B	Joshua Ridge_C	Joshua Ridge_D	Joshua Ridge_E	Joshua Ridge_F	Joshua Ridge_G
Ba	15.1	15.9	14.2	14.6	13.5	12.7	15.9	13.7	73.9	59.7	52.7	67.7	38.6	52.8	73.9
Ce	69.3	79.9	64.6	65.2	68.7	66.3	71.2	70.6	151.4	128.6	112.6	138.5	85.2	113.4	142.6
Dy	7.7	9.7	7.4	8.1	7.8	8.0	8.4	7.8	9.0	12.0	9.9	7.7	6.9	9.5	7.7
Er	4.4	5.6	4.3	4.6	4.4	4.6	4.9	4.4	5.0	7.0	5.7	4.3	4.0	5.5	4.2
Eu	0.08	0.10	0.08	0.08	0.08	0.08	0.08	0.08	0.22	0.16	0.13	0.19	0.10	0.14	0.21
Fe	10850	11281	10218	10075	10301	9690	9984	10085	13702	12827	11814	12862	9724	11797	12850
Ga	60.3	54.5	59.9	61.3	53.8	54.2	54.3	53.3	52.6	56.3	59.6	53.1	51.2	52.8	44.9
Gd	6.7	8.4	6.4	6.8	6.6	6.8	7.3	6.8	8.6	10.4	8.6	7.5	6.0	8.3	7.5
Ho	1.52	1.91	1.48	1.60	1.53	1.58	1.65	1.56	1.79	2.35	1.99	1.50	1.35	1.90	1.53
Lu	0.60	0.76	0.59	0.63	0.60	0.64	0.67	0.63	0.68	0.95	0.80	0.57	0.55	0.76	0.57
Mn	595	647	566	557	583	544	562	573	550	587	541	496	423	539	516
Nb	103	113	101	101	103	102	109	108	94	122	115	87	89	112	87
Nd	24.7	29.9	23.3	24.2	24.9	25.1	26.8	25.1	46.4	43.7	36.4	41.0	26.2	37.0	42.1
Pr	6.6	8.0	6.2	6.4	6.7	6.5	7.0	6.8	13.6	12.3	10.4	12.1	7.5	10.4	12.1
Rb	267	257	269	280	258	273	280	275	214	280	298	223	259	286	196
Sm	6.7	8.0	6.5	6.6	6.4	6.6	7.3	6.9	9.8	11.2	8.9	8.6	6.4	9.2	8.3
Sr	4.5	4.9	4.0	4.1	4.1	3.8	4.7	4.0	12.2	11.0	10.1	11.2	6.7	9.9	12.3
Tb	1.2	1.5	1.1	1.2	1.2	1.2	1.3	1.2	1.4	1.9	1.5	1.2	1.1	1.5	1.2
Ti	585	669	569	601	610	571	645	633	1079	960	844	981	661	873	1043
Tm	0.68	0.87	0.66	0.71	0.68	0.71	0.75	0.69	0.75	1.08	0.88	0.64	0.61	0.85	0.64
Y	30.8	38.8	28.9	31.4	30.5	31.7	34.3	31.2	34.8	48.5	38.9	29.5	27.6	38.4	29.1
Yb	4.6	5.8	4.4	4.8	4.6	4.8	5.0	4.8	5.0	7.3	6.0	4.4	4.2	5.8	4.4
Zn	313	265	304	307	261	255	254	249	244	272	276	289	315	264	222
Zr	260	326	247	264	260	268	305	278	468	494	393	406	279	394	411

*All data in PPM

Appendix I cont.: Individual Sample Data from Laser Ablation Analysis.

Element	Joshua Ridge_H	Joshua Ridge_I	Joshua Ridge_J	Joshua Ridge_K	Joshua Ridge_L	Joshua Ridge_M	Joshua Ridge_N	Joshua Ridge_O	Joshua Ridge_P	Joshua Ridge_Q	Joshua Ridge_R	Joshua Ridge_S	Joshua Ridge_T	Joshua Ridge_U
Ba	56.8	53.3	107.5	52.9	47.9	45.6	41.9	63.2	43.5	45.2	56.9	43.8	45.6	38.7
Ce	118.8	110.0	122.7	115.1	105.9	98.3	93.9	121.9	98.0	103.1	118.0	99.5	98.6	93.4
Dy	10.1	8.7	10.5	10.5	8.4	7.8	7.3	6.4	7.9	8.2	6.2	7.9	7.6	7.5
Er	5.8	4.9	6.1	6.2	4.8	4.4	4.1	3.5	4.4	4.7	3.4	4.5	4.4	4.3
Eu	0.13	0.13	0.26	0.14	0.12	0.11	0.10	0.16	0.10	0.11	0.15	0.11	0.11	0.10
Fe	11666	11184	15789	11910	11665	10776	10607	11835	10968	11471	11773	11260	11530	11223
Ga	51.0	49.8	54.2	54.0	51.6	49.5	51.7	49.7	54.7	55.0	55.6	60.2	59.2	58.5
Gd	8.8	7.5	8.9	9.1	7.4	6.8	6.4	6.2	6.8	7.2	6.0	6.9	6.7	6.5
Ho	1.99	1.66	2.05	2.11	1.66	1.52	1.42	1.24	1.50	1.61	1.19	1.53	1.53	1.50
Lu	0.80	0.67	0.82	0.86	0.66	0.61	0.57	0.47	0.61	0.66	0.46	0.63	0.61	0.58
Mn	551	530	862	550	533	497	478	470	503	520	474	529	536	514
Nb	117	111	115	116	112	104	103	80	105	109	79	107	105	102
Nd	38.2	34.2	39.9	39.1	32.9	30.6	28.0	34.3	29.5	30.7	32.3	30.2	29.4	28.6
Pr	10.9	9.6	10.7	10.9	9.3	8.8	8.3	10.3	8.5	9.0	9.6	8.7	8.4	8.0
Rb	277	267	283	261	257	265	283	208	282	280	222	292	289	303
Sm	9.3	7.9	9.2	9.3	7.6	7.2	6.8	7.3	6.9	7.5	6.6	7.2	6.9	6.8
Sr	10.2	9.1	16.0	9.9	8.9	8.1	7.4	10.3	8.1	8.2	9.3	7.9	8.2	7.3
Tb	1.6	1.3	1.6	1.6	1.3	1.2	1.1	1.0	1.2	1.3	1.0	1.2	1.2	1.2
Ti	870	804	1378	884	825	806	738	915	758	765	876	754	747	722
Tm	0.89	0.76	0.93	0.94	0.76	0.70	0.65	0.54	0.69	0.74	0.52	0.71	0.67	0.67
Y	40.3	34.5	40.9	43.0	33.6	30.8	29.0	24.5	31.1	32.7	23.5	31.4	30.1	29.7
Yb	6.1	5.2	6.2	6.5	5.2	4.8	4.4	3.7	4.7	5.0	3.5	4.8	4.7	4.5
Zn	234	238	271	223	231	225	233	241	254	256	290	291	292	281
Zr	416	357	417	428	344	323	307	347	324	341	331	330	317	305

Element	Joshua RidgeB_A	Joshua RidgeB_B	Joshua RidgeB_C	Joshua RidgeB_D	Joshua RidgeB_E	Joshua RidgeB_F	Joshua RidgeB_G	Joshua RidgeB_H	Joshua RidgeB_I	Joshua RidgeB_J	Joshua RidgeB_K	Joshua RidgeB_L	North Stewart_A	North Stewart_B
Ba	71.4	49.6	52.7	48.0	51.8	68.2	51.6	70.0	50.6	70.6	51.1	50.0	4.0	4.1
Ce	136.8	115.0	115.7	109.6	110.5	136.1	112.8	138.6	111.3	141.6	113.7	113.1	80.9	76.8
Dy	7.9	10.2	10.2	9.2	9.5	7.7	9.9	7.9	9.4	8.0	9.8	10.1	14.2	13.8
Er	4.3	5.8	5.8	5.3	5.5	4.2	5.7	4.3	5.4	4.3	5.6	5.8	8.0	7.7
Eu	0.19	0.13	0.13	0.12	0.13	0.18	0.13	0.19	0.11	0.20	0.13	0.13	0.03	0.03
Fe	11842	11446	11756	11287	11692	13013	12043	13027	11997	13104	12071	12117	11913	12328
Ga	52.5	57.4	56.6	56.7	57.7	51.8	56.9	54.9	58.6	53.8	56.1	56.6	74.8	83.1
Gd	7.5	8.8	8.8	8.1	8.4	7.3	8.4	7.5	8.1	7.7	8.4	8.7	12.0	11.9
Ho	1.50	1.98	2.00	1.82	1.91	1.50	1.91	1.49	1.85	1.56	1.95	2.02	2.85	2.68
Lu	0.58	0.80	0.81	0.74	0.76	0.56	0.78	0.58	0.74	0.58	0.76	0.81	1.04	1.00
Mn	483	534	547	533	553	539	570	533	564	533	572	576	580	575
Nb	88	119	119	115	118	87	116	91	117	91	115	116	173	168
Nd	40.2	37.6	38.1	34.8	35.6	40.2	36.7	41.2	35.1	41.7	37.1	37.1	35.4	34.2
Pr	11.9	10.6	10.6	10.0	10.1	11.8	10.5	12.1	10.0	12.5	10.4	10.5	8.6	8.3
Rb	223	303	295	283	287	198	277	215	290	212	268	283	411	436
Sm	8.1	8.9	9.3	8.3	8.7	8.2	8.8	8.5	8.4	8.8	8.7	8.9	11.2	11.2
Sr	11.4	8.9	9.4	8.5	10.4	11.1	9.1	11.4	9.9	11.4	9.2	8.9	2.5	2.2
Tb	1.2	1.6	1.6	1.4	1.5	1.2	1.5	1.2	1.4	1.3	1.5	1.5	2.2	2.2
Ti	961	801	797	767	815	942	793	949	786	962	777	793	604	552
Tm	0.66	0.90	0.91	0.84	0.85	0.64	0.88	0.65	0.84	0.67	0.87	0.90	1.21	1.16
Y	29.2	40.3	41.2	36.9	38.6	28.9	39.3	29.9	37.8	30.5	38.9	40.5	54.4	53.5
Yb	4.4	6.1	6.2	5.6	5.8	4.4	5.9	4.4	5.6	4.4	5.8	6.1	8.1	7.6
Zn	257	271	266	292	278	293	282	297	302	305	280	274	393	478
Zr	404	403	408	370	382	381	386	405	372	411	386	394	634	348

*All data in PPM

Appendix I cont.: Individual Sample Data from Laser Ablation Analysis.

Element	North Stewart_C	North Stewart_D	North Stewart_E	North Stewart_F	North Stewart_G	North Stewart_H	North Stewart_I	North Stewart_J	SES_Transect _0_0	SES_Transect _0N15W	SES_Transect _0N3W
Ba	3.4	3.6	3.5	3.1	3.7	3.5	4.2	3.9	52.9	47.4	46.9
Ce	73.3	70.4	68.5	66.1	71.8	72.2	78.2	77.3	114.8	105.5	102.9
Dy	12.7	12.1	11.5	11.2	12.5	11.9	13.5	13.6	10.2	9.1	8.4
Er	7.1	6.7	6.4	6.3	6.9	6.7	7.5	7.6	5.8	5.2	4.8
Eu	0.03	0.02	0.03	0.02	0.02	0.02	0.03	0.03	0.14	0.12	0.11
Fe	11192	10876	10886	10430	11199	11010	11880	11981	11424	10554	10616
Ga	73.6	65.3	72.0	59.0	72.3	68.9	72.3	71.8	63.7	60.2	57.5
Gd	11.0	10.6	9.8	9.8	10.8	10.3	11.5	11.3	8.9	7.8	7.3
Ho	2.48	2.31	2.21	2.20	2.46	2.33	2.69	2.60	2.05	1.83	1.66
Lu	0.92	0.88	0.84	0.83	0.91	0.87	1.00	0.98	0.82	0.71	0.67
Mn	538	524	523	500	542	547	553	551	522	500	491
Nb	157	150	150	140	155	154	172	173	116	109	105
Nd	32.3	30.3	28.4	27.7	31.0	29.6	33.0	32.5	38.3	33.9	32.3
Pr	7.7	7.4	7.0	6.9	7.6	7.5	8.4	8.3	10.7	9.8	9.6
Rb	387	343	389	312	362	332	374	387	342	308	305
Sm	10.3	9.8	9.2	9.1	10.4	9.7	11.0	10.6	9.2	7.9	7.9
Sr	2.0	1.9	1.8	1.7	1.9	2.0	2.2	2.1	9.6	9.0	8.5
Tb	2.0	1.9	1.8	1.7	1.9	1.9	2.1	2.1	1.6	1.4	1.3
Ti	548	547	517	512	555	544	601	590	784	738	717
Tm	1.06	1.02	0.97	0.94	1.04	1.00	1.15	1.13	0.92	0.81	0.74
Y	48.1	46.5	44.3	43.5	48.0	46.0	51.0	50.2	40.2	35.4	33.1
Yb	7.0	6.7	6.4	6.3	6.9	6.6	7.6	7.6	6.2	5.5	5.0
Zn	387	350	401	316	384	377	384	380	311	303	326
Zr	331	323	301	307	329	319	361	354	408	368	339

Element	SES_Transect _0S40W	SES_Transect _10S40W	SES_Transect _15N15W	SES_Transect _15S40W	SES_Transect _18S40W	SES_Transect _22S40W	SES_Transect _25S40W	SES_Transect _29S40W	SES_Transect _3N15W	SES_Transect _4S40W	SES_Transect _7S40W
Ba	55.8	50.2	46.0	50.9	53.6	52.7	49.7	46.5	49.0	52.8	52.2
Ce	110.9	107.3	101.0	108.9	110.8	106.9	107.1	100.8	104.8	103.2	105.2
Dy	9.4	9.4	8.8	9.6	9.7	9.2	9.4	8.0	9.0	9.0	9.3
Er	5.4	5.4	5.1	5.5	5.5	5.2	5.3	4.6	5.1	5.1	5.3
Eu	0.14	0.13	0.11	0.12	0.13	0.13	0.13	0.11	0.12	0.12	0.13
Fe	11288	11006	10279	11218	11440	11568	11560	10493	10941	11060	11425
Ga	60.8	59.8	60.7	62.1	67.0	63.1	65.8	57.9	57.0	62.9	64.5
Gd	8.1	8.2	7.6	8.3	8.5	8.0	8.2	7.0	7.7	7.8	8.1
Ho	1.86	1.88	1.73	1.91	1.95	1.79	1.86	1.56	1.71	1.75	1.83
Lu	0.76	0.75	0.70	0.76	0.79	0.72	0.74	0.65	0.70	0.73	0.74
Mn	546	512	487	508	513	524	518	507	498	510	530
Nb	111	110	106	113	114	111	112	104	109	106	112
Nd	35.9	36.0	33.0	36.0	36.7	35.2	35.3	30.9	34.2	33.6	35.5
Pr	10.0	10.1	9.4	10.1	10.0	9.9	10.0	9.1	9.7	9.7	10.0
Rb	330	325	324	355	364	351	348	279	318	327	361
Sm	8.5	8.6	7.9	8.6	9.1	8.5	8.5	7.4	8.1	7.9	8.8
Sr	9.8	9.5	8.6	9.1	9.7	10.2	9.1	8.5	9.0	9.1	10.0
Tb	1.5	1.5	1.4	1.5	1.5	1.4	1.5	1.2	1.4	1.4	1.5
Ti	809	767	709	765	799	833	740	716	754	791	785
Tm	0.84	0.84	0.78	0.84	0.89	0.81	0.84	0.71	0.79	0.81	0.84
Y	36.7	36.4	34.8	38.2	38.1	36.5	37.0	32.0	34.8	35.1	38.0
Yb	5.7	5.7	5.3	5.8	5.9	5.6	5.7	5.0	5.4	5.5	5.6
Zn	308	329	319	331	382	362	374	331	283	337	349
Zr	378	375	356	387	384	373	377	333	359	357	382

*All data in PPM

Appendix I cont.: Individual Sample Data from Laser Ablation Analysis.

Element	SESugar1_A	SESugar1_B	SESugar1_C	SESugar1_D	SESugar1_E	SESugar1_F	SESugar1_G	SESugar1_H	SESugar1_I	SESugar1_J	SESugar1_K	SESugar1_L	SESugar1_M
Ba	47.5	43.4	46.1	47.7	48.8	44.5	43.1	42.7	44.9	43.0	47.2	46.9	43.6
Ce	108.2	102.7	103.7	102.6	111.7	97.7	97.7	96.8	96.0	98.3	101.3	100.0	98.7
Dy	8.9	8.2	8.4	8.0	9.4	7.5	7.9	7.7	7.4	7.3	7.8	7.7	7.4
Er	5.1	4.7	4.8	4.6	5.4	4.3	4.5	4.4	4.2	4.2	4.4	4.4	4.2
Eu	0.12	0.11	0.12	0.12	0.13	0.11	0.11	0.11	0.12	0.11	0.11	0.12	0.11
Fe	12004	11742	11947	11904	12232	11417	11356	11198	11554	11555	11703	11270	11305
Ga	56.3	58.2	56.3	55.0	53.7	52.8	54.1	53.9	54.4	54.3	53.7	55.6	54.1
Gd	7.8	7.2	7.4	7.0	8.2	6.5	6.8	6.7	6.5	6.5	6.9	6.7	6.5
Ho	1.77	1.62	1.69	1.57	1.91	1.47	1.51	1.51	1.47	1.41	1.53	1.47	1.42
Lu	0.70	0.66	0.66	0.63	0.74	0.59	0.61	0.61	0.58	0.57	0.59	0.59	0.57
Mn	549	544	560	542	575	522	519	517	520	529	534	525	523
Nb	111	106	106	103	109	100	101	103	101	103	105	106	104
Nd	34.1	31.8	31.3	31.3	35.8	29.2	29.4	29.5	28.8	29.0	30.4	29.3	28.8
Pr	9.7	9.0	9.1	9.0	10.2	8.6	8.6	8.5	8.4	8.6	8.8	8.8	8.4
Rb	272	268	264	256	251	257	262	269	269	272	279	287	287
Sm	8.2	7.5	7.5	7.3	8.7	6.8	7.2	7.5	6.9	7.0	7.5	6.9	7.0
Sr	8.6	8.0	8.4	8.5	9.2	7.9	7.9	8.0	8.1	7.8	8.9	9.1	8.1
Tb	1.4	1.3	1.3	1.2	1.4	1.2	1.2	1.2	1.1	1.1	1.2	1.2	1.1
Ti	787	760	757	764	801	731	736	736	741	755	781	788	756
Tm	0.78	0.73	0.75	0.72	0.82	0.66	0.70	0.68	0.66	0.64	0.67	0.68	0.64
Y	36.0	33.0	33.4	31.4	37.0	29.7	30.9	30.5	29.7	29.0	31.1	30.5	29.4
Yb	5.3	5.1	5.0	4.9	5.6	4.5	4.8	4.6	4.5	4.5	4.6	4.6	4.5
Zn	269	290	273	291	260	281	266	269	290	283	266	278	280
Zr	352	331	331	319	373	307	312	311	308	302	321	316	304

Element	SESugar1_N	SESugar1_O	SESugar1_P	SESugar1_Q	SESugar1_R	SESugar1_S	SESugar1_T	SESugar1_U	SESugar1_V	SESugar2_A	SESugar2_B	SESugar2_C	SESugar2_D
Ba	44.0	45.6	37.9	41.0	43.2	43.4	46.7	45.9	45.1	46.6	47.9	50.9	48.5
Ce	96.7	98.2	89.9	94.0	96.4	98.8	105.2	100.1	99.9	107.9	108.9	113.7	108.7
Dy	7.5	7.6	6.9	7.8	7.5	7.9	8.7	8.0	8.0	8.6	8.8	9.4	8.8
Er	4.3	4.4	4.0	4.5	4.3	4.5	5.0	4.6	4.6	4.9	5.1	5.3	4.9
Eu	0.11	0.11	0.09	0.10	0.11	0.10	0.12	0.12	0.11	0.12	0.12	0.13	0.12
Fe	11700	11633	10969	10694	11350	11468	11983	11632	11409	12556	13058	12776	12718
Ga	56.4	55.6	51.9	53.8	51.9	52.8	52.5	52.4	54.3	63.8	62.8	59.7	60.5
Gd	6.6	6.7	6.1	6.8	6.6	6.8	7.5	7.0	6.9	7.6	7.7	8.2	7.7
Ho	1.45	1.51	1.36	1.56	1.44	1.56	1.70	1.58	1.55	1.71	1.74	1.84	1.69
Lu	0.59	0.60	0.54	0.61	0.59	0.62	0.68	0.63	0.63	0.69	0.70	0.74	0.68
Mn	519	521	486	484	510	515	542	518	518	568	575	587	564
Nb	104	104	99	102	103	105	107	103	106	108	111	114	110
Nd	29.2	29.1	26.8	29.1	29.4	30.1	33.5	30.2	30.0	33.3	34.0	36.5	34.3
Pr	8.5	8.7	7.7	8.1	8.2	8.7	9.3	8.7	8.6	9.1	9.3	10.2	9.4
Rb	289	287	270	278	266	267	260	264	279	292	290	275	284
Sm	7.0	7.1	6.3	6.8	6.9	7.3	7.9	7.1	7.3	7.8	7.8	8.4	8.0
Sr	8.0	8.4	6.6	7.4	7.6	7.8	8.5	8.2	7.9	8.3	8.5	9.5	8.8
Tb	1.2	1.2	1.1	1.2	1.1	1.2	1.3	1.2	1.2	1.3	1.4	1.4	1.3
Ti	752	756	673	700	732	741	768	748	750	735	738	782	753
Tm	0.67	0.68	0.61	0.69	0.67	0.70	0.77	0.70	0.70	0.76	0.78	0.83	0.76
Y	29.8	30.5	27.6	31.2	30.6	31.4	34.5	31.2	31.2	34.4	35.3	37.2	34.3
Yb	4.6	4.7	4.2	4.6	4.5	4.7	5.2	4.8	4.8	5.2	5.2	5.6	5.3
Zn	298	272	265	268	249	248	252	245	253	336	325	300	319
Zr	307	316	283	315	307	317	344	319	316	339	348	375	344

*All data in PPM

Appendix I cont.: Individual Sample Data from Laser Ablation Analysis.

Element	SESugar2_E	SESugar2_F	SESugar2_G	SESugar2_H	SESugar2_I	SESugar2_J	SESugar2_K	SESugar2_L	South Stewart_A	South Stewart_B	South Stewart_C	South Stewart_D	South Stewart_E
Ba	45.8	46.0	45.6	45.1	45.6	46.0	45.1	47.9	3.6	3.4	3.4	3.4	3.5
Ce	103.2	103.6	103.6	103.6	106.5	107.1	106.9	107.3	68.7	70.0	69.3	71.8	76.3
Dy	8.1	8.7	8.6	8.4	8.5	8.7	8.9	9.2	12.0	12.1	11.6	12.2	13.0
Er	4.6	5.0	4.9	4.8	4.9	5.0	5.1	5.2	6.6	6.6	6.3	6.7	7.2
Eu	0.11	0.12	0.12	0.12	0.12	0.12	0.11	0.13	0.02	0.03	0.02	0.03	0.03
Fe	11969	11837	11761	11500	11739	11716	11500	11636	10240	10532	10538	10876	11146
Ga	60.8	63.2	61.1	60.9	59.1	60.2	62.0	61.8	68.9	71.7	69.3	70.4	68.5
Gd	7.0	7.5	7.5	7.3	7.3	7.5	7.7	7.8	10.2	10.2	9.8	10.3	11.0
Ho	1.62	1.72	1.67	1.67	1.67	1.66	1.78	1.79	2.33	2.36	2.18	2.38	2.52
Lu	0.65	0.69	0.68	0.67	0.68	0.69	0.72	0.73	0.90	0.89	0.86	0.89	0.96
Mn	545	540	540	529	535	529	530	528	483	500	505	513	542
Nb	108	108	108	105	108	108	109	108	159	161	161	164	170
Nd	32.4	33.4	33.5	32.5	33.3	33.8	34.1	34.4	29.3	29.1	28.7	30.1	32.5
Pr	8.9	9.1	9.1	9.1	9.4	9.3	9.5	9.7	7.4	7.3	7.3	7.6	8.0
Rb	287	294	292	288	283	288	295	293	376	392	389	399	379
Sm	7.4	7.8	8.0	7.5	8.0	7.9	7.9	8.1	9.4	9.3	9.1	9.5	10.8
Sr	8.0	8.4	8.4	8.4	8.3	8.6	8.2	8.8	2.0	1.9	2.0	2.0	2.2
Tb	1.3	1.3	1.3	1.3	1.3	1.3	1.4	1.4	1.8	1.9	1.8	1.9	2.0
Ti	738	729	737	728	745	737	746	746	548	543	551	567	585
Tm	0.71	0.77	0.76	0.74	0.75	0.76	0.80	0.82	1.00	1.01	0.97	1.02	1.09
Y	32.5	34.2	34.1	32.9	33.5	33.9	34.9	35.7	45.8	45.2	44.1	45.4	49.3
Yb	4.9	5.2	5.2	5.1	5.2	5.3	5.5	5.5	6.7	6.8	6.5	6.8	7.3
Zn	330	330	315	321	308	324	317	308	389	391	375	380	351
Zr	327	344	339	334	342	340	348	363	323	322	313	322	352

Element	South Stewart_F	South Stewart_G	South Stewart_H	South Stewart_I	South Stewart_J	South Stewart_K	South Stewart_L	South Stewart_M	South Stewart_N	South Sugar1_A	South Sugar1_B	South Sugar1_C	South Sugar1_D
Ba	3.9	3.7	3.9	3.9	4.0	4.1	4.0	4.1	4.3	51.6	47.0	48.3	47.8
Ce	74.4	73.4	77.8	78.5	78.6	83.1	84.1	83.1	82.0	101.6	104.3	102.7	106.4
Dy	12.5	12.8	14.3	14.1	14.3	14.4	14.9	14.7	14.2	7.0	8.2	7.9	8.6
Er	6.9	7.1	7.9	7.8	7.9	8.1	8.3	8.2	8.0	4.0	4.8	4.5	4.9
Eu	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.12	0.12	0.12	0.11
Fe	11246	11238	11291	11658	11667	12226	12097	12202	12069	11432	11264	11680	11461
Ga	71.5	77.4	68.5	82.0	82.2	80.3	83.8	82.9	78.0	54.4	55.5	55.6	57.1
Gd	10.6	10.6	12.2	11.8	11.6	12.1	12.3	12.1	11.9	6.2	7.1	6.9	7.5
Ho	2.39	2.47	2.78	2.72	2.82	2.89	2.87	2.89	2.78	1.40	1.61	1.54	1.69
Lu	0.92	0.94	1.04	1.04	1.06	1.08	1.09	1.08	1.03	0.54	0.65	0.62	0.67
Mn	538	527	541	549	546	577	580	574	578	507	522	524	519
Nb	167	167	169	175	179	183	183	181	177	105	113	111	113
Nd	31.2	31.1	34.9	34.3	35.1	36.0	36.6	35.3	35.2	28.6	31.5	30.4	32.1
Pr	7.9	8.0	8.7	8.6	8.7	9.1	9.3	9.1	8.8	8.5	8.7	8.6	9.2
Rb	389	436	371	444	465	451	471	464	437	287	297	293	288
Sm	9.8	10.1	11.3	10.8	10.9	11.8	11.5	11.3	11.3	6.7	7.4	7.1	7.6
Sr	2.3	2.2	2.5	2.4	2.4	2.5	2.5	2.6	2.4	8.5	8.3	8.6	8.5
Tb	1.9	2.0	2.2	2.2	2.2	2.3	2.3	2.3	2.2	1.1	1.3	1.2	1.3
Ti	570	556	605	577	576	593	600	586	592	782	811	806	800
Tm	1.05	1.06	1.21	1.18	1.19	1.21	1.24	1.23	1.18	0.61	0.73	0.70	0.77
Y	48.1	47.9	53.9	53.4	54.3	55.6	56.1	55.6	53.4	26.9	32.3	30.8	33.5
Yb	7.1	7.2	8.0	7.9	8.1	8.2	8.3	8.3	8.0	4.1	4.9	4.7	5.2
Zn	401	425	353	446	450	434	464	436	405	255	243	251	261
Zr	339	332	379	365	367	375	381	377	362	299	340	328	353

*All data in PPM

Appendix I cont.: Individual Sample Data from Laser Ablation Analysis.

Element	South Sugar1_E	South Sugar1_F	South Sugar1_G	South Sugar1_H	South Sugar1_I	South Sugar1_J	South Sugar1_K	South Sugar1_L	South Sugar2_A	South Sugar2_B	South Sugar2_C	South Sugar2_D	South Sugar2_E	South Sugar2_F	South Sugar2_G
Ba	52.0	66.7	58.2	62.8	48.4	50.5	46.9	46.7	54.5	41.0	43.9	39.2	64.4	45.2	61.5
Ce	106.0	114.8	105.8	118.4	104.4	100.7	103.3	103.3	98.0	92.5	95.5	83.4	102.5	99.6	107.8
Dy	7.6	8.0	7.8	9.4	7.7	7.7	8.1	8.3	6.4	6.9	7.1	6.1	6.3	7.7	7.3
Er	4.4	4.5	4.5	5.4	4.4	4.5	4.7	4.8	3.6	4.0	4.1	3.5	3.6	4.4	4.1
Eu	0.12	0.14	0.13	0.14	0.11	0.13	0.11	0.11	0.11	0.10	0.11	0.09	0.13	0.11	0.13
Fe	11292	11693	11639	12280	11460	11121	11432	11327	11190	11129	11501	10272	11277	12029	11946
Ga	57.4	52.3	53.4	52.6	53.7	47.8	53.2	52.8	53.9	55.3	55.5	56.2	54.8	57.5	56.2
Gd	6.8	7.2	6.9	8.3	6.8	6.8	7.1	7.2	5.7	6.1	6.3	5.5	5.8	6.7	6.6
Ho	1.50	1.59	1.54	1.84	1.50	1.48	1.60	1.63	1.25	1.35	1.36	1.16	1.24	1.52	1.42
Lu	0.60	0.62	0.62	0.75	0.60	0.62	0.66	0.65	0.49	0.54	0.55	0.48	0.49	0.59	0.57
Mn	511	528	507	554	515	482	516	514	525	518	529	477	525	546	544
Nb	110	109	108	115	110	99	111	111	96	101	102	93	94	105	97
Nd	29.6	32.2	30.7	37.1	30.4	29.9	30.8	31.6	27.5	27.1	28.3	24.0	28.2	29.0	30.9
Pr	8.7	9.5	8.9	10.5	8.9	8.7	8.9	8.8	8.2	8.0	8.3	7.1	8.5	8.5	9.0
Rb	294	269	270	264	270	240	273	271	266	287	283	282	264	283	261
Sm	7.2	7.5	7.3	8.5	7.2	7.1	7.0	7.2	6.2	6.3	6.5	5.8	6.1	7.2	7.2
Sr	8.4	11.0	9.8	10.8	8.7	8.8	8.4	8.3	8.8	7.4	8.0	6.6	10.1	8.0	9.8
Tb	1.2	1.3	1.2	1.5	1.2	1.2	1.3	1.3	1.0	1.1	1.1	0.9	1.0	1.2	1.1
Ti	826	901	869	907	823	765	810	815	767	738	753	669	814	787	802
Tm	0.68	0.69	0.69	0.83	0.69	0.69	0.73	0.74	0.56	0.61	0.63	0.53	0.54	0.67	0.64
Y	30.1	31.0	30.6	37.6	30.9	31.4	33.0	33.2	25.1	27.9	29.2	24.7	24.7	29.5	28.8
Yb	4.6	4.7	4.7	5.7	4.7	4.7	5.0	5.1	3.8	4.2	4.3	3.7	3.8	4.6	4.3
Zn	245	221	226	220	236	237	229	231	268	263	270	305	270	266	277
Zr	329	359	335	405	325	335	338	341	292	292	307	258	305	306	325

Element	South Sugar2_H	South Sugar2_I	South Sugar2_J	South Sugar2_K	South Sugar2_L	South Sugar2_M	South Sugar2_N	South Sugar2_O	South Sugar3a_A	South Sugar3a_B	South Sugar3a_C	South Sugar3a_D	South Sugar3a_E	South Sugar3a_F	South Sugar3a_G
Ba	59.1	67.8	82.7	57.4	80.5	59.0	55.3	83.8	71.2	73.2	47.4	66.4	84.2	55.9	65.5
Ce	107.7	112.0	118.4	109.3	119.9	106.6	106.2	115.3	116.1	116.1	106.7	113.6	119.1	104.6	108.2
Dy	7.4	7.4	7.3	7.9	7.6	7.7	8.0	7.2	8.7	8.4	9.0	8.7	8.2	8.4	8.6
Er	4.1	4.2	4.0	4.5	4.3	4.4	4.5	4.1	5.0	4.8	5.2	5.0	4.7	4.9	4.9
Eu	0.13	0.14	0.16	0.13	0.17	0.13	0.12	0.17	0.14	0.14	0.12	0.14	0.16	0.13	0.14
Fe	11847	11482	12064	11686	11537	11409	10921	10900	11801	11751	11295	11179	11663	10698	11280
Ga	57.6	55.2	55.2	53.5	54.0	55.7	54.1	52.0	56.4	59.0	58.9	57.6	59.7	59.7	59.5
Gd	6.7	6.7	6.7	7.0	7.0	6.9	7.0	6.6	7.6	7.4	7.8	7.6	7.3	7.3	7.6
Ho	1.43	1.46	1.40	1.57	1.49	1.50	1.58	1.40	1.70	1.67	1.77	1.66	1.59	1.63	1.68
Lu	0.57	0.58	0.56	0.61	0.59	0.61	0.62	0.55	0.67	0.66	0.71	0.68	0.63	0.66	0.67
Mn	541	531	533	520	531	504	501	506	526	524	509	515	524	494	510
Nb	99	97	93	104	96	103	106	95	103	103	111	101	94	99	100
Nd	31.2	32.5	34.4	32.9	35.6	31.9	32.3	32.9	35.2	34.4	33.1	35.1	36.2	33.0	34.6
Pr	9.1	9.4	10.0	9.5	10.3	9.2	9.1	9.8	10.1	10.0	9.5	10.1	10.5	9.4	9.8
Rb	269	254	242	259	247	270	271	245	287	308	328	290	286	313	316
Sm	7.2	7.3	7.3	7.2	7.5	7.3	7.3	6.8	8.2	7.9	8.0	8.0	8.0	7.6	8.1
Sr	9.7	10.8	12.8	10.3	12.5	9.6	9.3	12.9	11.5	11.6	8.6	10.5	12.9	9.5	11.1
Tb	1.1	1.2	1.1	1.2	1.2	1.2	1.2	1.1	1.3	1.3	1.4	1.3	1.3	1.3	1.3
Ti	798	812	868	808	876	798	790	872	834	840	755	801	834	738	777
Tm	0.64	0.65	0.63	0.69	0.66	0.68	0.70	0.62	0.76	0.74	0.80	0.77	0.71	0.75	0.75
Y	29.2	29.3	28.1	31.5	29.9	30.7	31.3	28.0	33.3	32.5	35.0	33.3	31.9	32.6	33.7
Yb	4.4	4.4	4.2	4.7	4.5	4.6	4.7	4.3	5.2	5.0	5.4	5.2	4.8	5.0	5.1
Zn	283	275	281	263	272	256	228	226	271	297	287	306	304	309	298
Zr	330	345	360	345	378	346	346	364	387	372	362	380	396	356	377

*All data in PPM

Appendix I cont.: Individual Sample Data from Laser Ablation Analysis.

Element	South Sugar3a_H	South Sugar3a_I	South Sugar3a_J	South Sugar3a_K	South Sugar3a_L	South Sugar3a_M	South Sugar3a_N	South Sugar3a_O	South Sugar3b_A	South Sugar3b_B	South Sugar3b_C	South Sugar3b_D	South Sugar3b_E	South Sugar3b_F
Ba	66.9	56.8	90.9	65.2	69.0	85.6	73.1	57.7	46.0	47.0	48.3	49.3	46.4	46.7
Ce	108.3	102.6	117.7	108.7	114.4	115.5	108.8	96.1	99.6	100.3	104.8	106.7	102.2	102.7
Dy	8.3	8.2	8.9	8.6	9.3	8.1	7.9	7.7	8.6	8.4	8.6	8.8	9.1	8.8
Er	4.7	4.7	5.0	4.9	5.3	4.6	4.4	4.4	4.9	4.8	4.9	5.0	5.1	5.1
Eu	0.14	0.13	0.18	0.13	0.14	0.16	0.15	0.13	0.12	0.12	0.12	0.12	0.12	0.12
Fe	10989	10513	11215	10409	11143	11333	10961	9050	10607	10752	10615	10761	10730	10692
Ga	57.5	57.5	54.3	57.9	55.6	55.9	61.1	42.4	59.8	59.6	54.6	56.6	60.3	60.5
Gd	7.3	7.1	8.0	7.6	8.2	7.2	7.1	7.0	7.3	7.3	7.7	7.7	7.7	7.7
Ho	1.57	1.59	1.74	1.69	1.82	1.58	1.52	1.47	1.63	1.67	1.68	1.76	1.80	1.76
Lu	0.66	0.65	0.67	0.67	0.74	0.63	0.61	0.60	0.68	0.66	0.68	0.70	0.71	0.72
Mn	504	483	511	493	527	510	497	439	499	507	514	524	498	501
Nb	99	97	95	102	107	96	97	87	106	106	107	107	104	105
Nd	33.3	32.5	38.7	34.6	37.8	36.0	33.9	31.8	32.0	31.8	33.4	32.6	33.2	32.1
Pr	9.6	9.2	10.9	9.7	10.6	10.3	9.7	8.7	9.0	9.2	9.4	9.5	9.3	9.5
Rb	307	315	271	316	302	277	308	203	315	315	287	300	320	320
Sm	8.0	7.8	8.8	7.9	8.6	8.0	7.8	7.2	7.4	7.9	7.8	8.1	8.0	7.9
Sr	10.7	9.6	14.0	10.7	11.1	13.7	11.8	8.3	8.4	8.3	8.3	8.8	8.5	8.4
Tb	1.3	1.3	1.4	1.3	1.5	1.3	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4
Ti	771	757	871	789	837	826	788	684	702	722	758	764	732	712
Tm	0.73	0.72	0.77	0.75	0.83	0.70	0.68	0.68	0.76	0.74	0.77	0.78	0.80	0.79
Y	32.4	32.0	34.7	33.0	36.3	31.0	30.2	28.0	32.9	32.9	33.4	34.3	35.3	34.7
Yb	5.0	4.9	5.2	5.1	5.6	4.8	4.7	4.6	5.2	5.1	5.3	5.4	5.4	5.4
Zn	288	291	270	280	274	296	314	229	311	314	274	277	303	300
Zr	363	351	425	368	399	383	361	326	342	338	351	361	366	359

Element	South Sugar3b_G	South Sugar3b_H	South Sugar3b_I	South Sugar3b_J	South Sugar3b_K	South Sugar3b_L	South Sugar3b_M	West Sugar1_A	West Sugar1_B	West Sugar1_C	West Sugar1_D	West Sugar1_E	West Sugar1_F	West Sugar1_G
Ba	45.8	45.9	45.9	47.5	46.2	44.9	47.4	60.4	56.0	64.0	56.1	49.6	88.6	49.0
Ce	103.3	102.2	104.3	105.3	102.0	103.1	103.9	116.9	119.7	121.9	115.1	109.4	111.9	102.9
Dy	8.6	8.8	8.8	9.2	8.8	8.8	8.8	9.0	9.7	9.4	9.0	8.7	9.3	7.9
Er	4.9	5.1	5.0	5.4	5.0	5.0	5.1	5.1	5.6	5.3	5.0	4.9	5.2	4.5
Eu	0.11	0.12	0.12	0.12	0.12	0.12	0.12	0.14	0.14	0.15	0.14	0.12	0.16	0.12
Fe	10518	10735	10701	10772	10723	10735	10694	11808	11469	11638	12033	11558	13034	11397
Ga	60.0	61.5	58.5	64.5	61.8	60.9	60.4	65.0	66.7	64.1	63.8	61.2	61.8	59.2
Gd	7.6	7.6	7.7	8.1	7.7	7.6	7.7	7.7	8.3	8.0	7.6	7.5	7.9	6.9
Ho	1.72	1.70	1.73	1.82	1.75	1.73	1.77	1.76	1.89	1.90	1.74	1.68	1.85	1.56
Lu	0.67	0.71	0.71	0.75	0.71	0.69	0.72	0.71	0.78	0.76	0.71	0.69	0.74	0.62
Mn	501	497	503	504	501	501	510	549	558	569	559	547	790	538
Nb	105	105	107	106	105	106	106	116	122	118	114	111	111	104
Nd	32.2	32.1	32.1	33.9	32.2	31.9	32.7	36.2	37.1	38.2	35.0	33.1	34.0	31.0
Pr	9.2	9.3	9.3	9.8	9.4	9.5	9.7	10.3	10.7	10.8	10.2	9.6	10.0	8.8
Rb	319	325	314	330	331	320	318	346	373	344	330	310	301	274
Sm	7.5	7.6	7.8	8.0	7.9	7.9	8.0	8.2	8.8	8.7	8.3	7.7	8.3	7.4
Sr	8.2	8.3	8.5	8.8	8.6	8.3	8.4	10.7	10.4	11.1	9.9	9.0	15.3	8.5
Tb	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.5	1.5	1.4	1.3	1.4	1.2
Ti	720	720	734	728	723	715	715	867	858	885	836	789	1005	752
Tm	0.77	0.78	0.78	0.82	0.79	0.78	0.79	0.79	0.86	0.83	0.79	0.77	0.83	0.70
Y	33.7	34.4	34.5	35.9	35.5	35.2	34.9	34.6	38.1	36.3	34.1	33.7	35.7	30.8
Yb	5.2	5.4	5.3	5.6	5.4	5.4	5.4	5.5	6.1	5.8	5.5	5.3	5.6	4.9
Zn	297	320	294	320	323	310	304	302	294	294	312	300	310	288
Zr	354	357	357	375	360	363	360	370	384	381	359	347	364	330

*All data in PPM

Appendix I cont.: Individual Sample Data from Laser Ablation Analysis.

Element	West Sugar1_H	West Sugar1_I	West Sugar1_J	West Sugar1_K	West Sugar1_L	West Sugar1_M	West Sugar1_N	West Sugar1_O	West Sugar2_B	West Sugar2_C	West Sugar2_D	West Sugar2_E	West Sugar2_F	West Sugar2_G	West Sugar2_H	West Sugar2_I
Ba	52.8	48.3	52.9	45.1	47.2	45.0	46.5	44.7	43.7	50.5	41.8	59.5	42.6	44.2	44.5	46.0
Ce	106.6	102.3	103.6	101.8	103.6	102.5	103.9	101.5	97.0	108.2	98.3	109.9	101.4	100.5	100.8	102.6
Dy	8.8	7.9	8.6	7.8	8.1	8.2	7.9	7.8	7.1	9.1	8.0	9.1	8.1	8.1	8.4	8.8
Er	5.0	4.4	4.8	4.4	4.6	4.6	4.5	4.5	4.1	5.3	4.7	5.3	4.7	4.7	4.9	5.1
Eu	0.12	0.12	0.12	0.11	0.12	0.12	0.13	0.11	0.11	0.13	0.11	0.14	0.11	0.11	0.11	0.12
Fe	11897	11324	11814	11782	11382	10907	11554	11367	11458	11834	11299	12151	11092	11555	11431	11782
Ga	57.6	58.9	56.9	57.5	57.2	57.2	57.3	56.5	51.7	53.9	55.3	54.2	54.8	54.4	54.5	53.3
Gd	7.7	7.0	7.4	6.9	7.1	7.0	7.0	6.8	6.2	8.0	7.0	7.9	7.0	7.1	7.3	7.7
Ho	1.74	1.51	1.66	1.54	1.60	1.63	1.59	1.59	1.37	1.74	1.58	1.78	1.58	1.63	1.65	1.75
Lu	0.70	0.62	0.67	0.61	0.65	0.64	0.62	0.61	0.56	0.73	0.64	0.72	0.64	0.64	0.66	0.69
Mn	550	539	544	539	535	527	539	537	521	553	510	555	531	529	519	534
Nb	104	103	105	106	104	105	106	104	103	110	104	108	106	105	105	106
Nd	33.5	30.7	31.9	30.0	31.3	31.4	31.2	30.4	28.4	34.6	30.2	35.3	30.7	30.8	31.6	32.3
Pr	9.5	9.0	9.2	8.8	9.0	8.9	9.0	8.7	8.1	9.7	8.5	9.9	8.7	8.6	8.8	9.3
Rb	258	277	273	270	274	274	276	272	262	261	275	261	264	265	270	271
Sm	8.3	7.6	7.4	7.2	7.4	7.3	7.4	7.1	6.6	8.4	7.2	8.0	7.3	7.5	7.5	7.8
Sr	9.3	8.8	9.2	8.3	8.6	8.5	8.7	8.4	7.6	9.2	7.6	10.3	8.0	8.1	8.3	8.7
Tb	1.4	1.2	1.3	1.2	1.2	1.3	1.2	1.2	1.1	1.4	1.2	1.4	1.2	1.3	1.3	1.4
Ti	752	748	751	744	769	757	761	749	751	803	739	815	761	750	755	768
Tm	0.78	0.70	0.77	0.69	0.71	0.73	0.70	0.69	0.63	0.82	0.71	0.81	0.72	0.72	0.75	0.78
Y	34.4	30.7	33.4	30.3	31.2	31.2	31.3	30.1	27.9	37.3	32.0	36.2	32.1	32.3	33.2	35.3
Yb	5.3	4.8	5.2	4.8	5.0	4.9	4.8	4.7	4.3	5.6	4.8	5.5	4.9	4.9	5.1	5.3
Zn	277	302	269	283	273	274	268	263	253	265	279	282	270	278	278	272
Zr	359	325	345	319	331	335	331	315	291	380	330	374	327	326	334	360

Element	West Sugar2_J	West Sugar2_K	West Sugar2_L	West Sugar2_M	West Sugar2_N	West Sugar2_O	West Sugar2_P	West Sugar2_Q	West Sugar2_R	West Sugar3_A	West Sugar3_B	West Sugar3_C	West Sugar3_D	West Sugar3_E	West Sugar3_F	West Sugar3_G
Ba	44.5	45.9	48.2	44.2	46.5	43.4	44.0	49.4	50.8	45.3	50.4	42.8	43.5	42.7	45.1	45.4
Ce	97.9	100.3	105.4	100.0	101.4	100.4	104.9	106.8	105.8	97.3	100.1	94.1	95.9	95.1	97.6	99.7
Dy	7.8	8.2	8.6	8.0	8.0	7.8	8.4	8.6	8.4	7.7	7.7	7.2	7.4	7.6	7.8	8.2
Er	4.4	4.7	5.0	4.6	4.5	4.5	4.8	4.9	4.8	4.4	4.3	4.1	4.2	4.3	4.4	4.7
Eu	0.11	0.11	0.13	0.12	0.12	0.11	0.12	0.12	0.12	0.11	0.12	0.10	0.10	0.10	0.11	0.12
Fe	11571	11095	11842	11186	11532	11403	11746	11348	11703	10838	10878	10361	10487	10822	11016	11140
Ga	51.0	51.2	51.8	51.0	53.7	51.9	54.1	56.3	54.8	52.2	50.4	52.8	52.8	54.8	56.5	58.2
Gd	6.7	7.2	7.5	7.0	6.9	6.9	7.3	7.5	7.4	6.7	6.8	6.4	6.5	6.5	6.6	7.0
Ho	1.48	1.63	1.71	1.56	1.54	1.54	1.70	1.70	1.66	1.48	1.50	1.37	1.43	1.45	1.54	1.64
Lu	0.60	0.64	0.67	0.62	0.62	0.61	0.66	0.68	0.67	0.60	0.61	0.56	0.59	0.60	0.61	0.65
Mn	534	522	541	526	515	521	541	536	534	497	508	475	486	500	497	514
Nb	104	105	105	105	102	105	106	107	105	102	103	98	101	102	102	104
Nd	29.2	30.6	32.6	30.5	30.3	29.9	32.1	32.9	32.2	30.0	30.2	28.1	28.5	29.0	29.3	31.1
Pr	8.7	8.8	9.2	8.7	8.8	8.7	9.1	9.5	9.4	8.5	8.7	8.0	8.2	8.3	8.4	8.8
Rb	263	265	256	251	261	253	256	261	259	269	267	280	287	294	300	301
Sm	7.2	7.6	8.0	7.0	7.3	7.4	7.9	7.9	7.9	7.0	7.2	7.0	6.9	6.7	6.9	7.2
Sr	8.0	8.2	8.9	8.1	8.4	8.0	8.3	8.9	9.0	8.2	8.9	7.4	7.8	7.7	8.1	8.3
Tb	1.2	1.3	1.3	1.2	1.2	1.2	1.3	1.3	1.3	1.2	1.2	1.1	1.1	1.2	1.2	1.3
Ti	748	754	763	745	752	734	755	758	768	734	766	710	736	743	744	757
Tm	0.68	0.73	0.76	0.70	0.70	0.69	0.74	0.76	0.74	0.68	0.68	0.63	0.66	0.66	0.69	0.72
Y	30.6	32.8	34.4	31.8	31.6	31.2	33.6	34.4	33.3	30.8	30.4	29.3	29.4	30.2	30.7	32.2
Yb	4.7	5.0	5.1	4.8	4.7	4.7	5.0	5.2	5.0	4.6	4.6	4.4	4.5	4.5	4.7	4.9
Zn	244	239	241	239	254	239	253	257	267	233	225	239	228	251	258	272
Zr	318	334	354	323	332	321	337	350	343	316	323	309	309	311	323	340

*All data in PPM

Appendix I cont.: Individual Sample Data from Laser Ablation Analysis.

West Sugar3_H	West Sugar3_I	West Sugar3_J	West Sugar3_K	West Sugar3_L	West Sugar3_M	West Sugar3_N	West Sugar3_O	West Sugar3_P	West Sugar4_A	West Sugar4_B	West Sugar4_C	West Sugar4_D	West Sugar4_E	West Sugar4_F	West Sugar4_G
45.7	42.7	45.0	44.0	46.8	46.8	52.4	52.0	56.4	45.3	45.2	48.6	45.9	45.1	45.6	44.0
100.3	98.0	98.8	98.5	99.3	100.3	102.5	104.1	109.9	104.4	104.3	108.3	104.4	102.0	102.3	99.6
8.0	7.6	7.5	7.8	7.4	7.6	8.1	8.1	8.6	8.7	8.5	8.6	8.6	8.3	8.5	8.0
4.5	4.4	4.3	4.6	4.3	4.3	4.6	4.6	4.9	5.0	4.9	4.9	4.9	4.7	4.9	4.6
0.11	0.11	0.11	0.10	0.11	0.11	0.12	0.12	0.13	0.11	0.12	0.12	0.12	0.12	0.12	0.12
11228	11044	11244	11209	11149	10833	11159	10895	11687	11494	11700	11728	11449	11591	11479	11252
59.1	57.2	57.4	59.1	56.5	56.8	59.3	60.0	62.0	59.9	60.3	59.7	62.0	62.2	61.5	62.9
6.9	6.5	6.6	6.7	6.6	6.6	7.0	6.9	7.4	7.5	7.4	7.6	7.3	7.2	7.4	7.0
1.56	1.43	1.47	1.52	1.45	1.40	1.58	1.61	1.68	1.73	1.66	1.65	1.69	1.64	1.71	1.60
0.62	0.58	0.58	0.61	0.58	0.57	0.64	0.64	0.68	0.68	0.69	0.68	0.68	0.64	0.68	0.64
519	515	523	516	513	509	512	519	538	528	531	543	529	535	524	521
104	104	103	104	103	104	105	107	112	106	107	109	107	105	105	103
30.9	29.0	29.4	30.2	29.7	29.9	32.2	31.7	33.7	32.8	32.6	33.5	32.3	31.5	32.2	30.1
8.9	8.4	8.6	8.6	8.6	8.5	8.9	9.2	9.8	9.3	9.2	9.3	9.1	9.0	8.9	8.8
308	298	298	305	292	297	309	318	331	288	290	293	293	285	291	296
7.7	6.9	6.8	7.2	7.0	7.0	7.4	7.6	8.1	7.7	7.6	7.9	7.5	7.3	7.7	7.2
8.3	7.5	7.9	7.9	8.1	8.3	9.1	9.2	10.0	8.5	8.4	8.9	8.2	8.3	8.4	7.8
1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.2
753	726	743	742	740	742	755	769	820	736	745	777	746	745	739	720
0.70	0.67	0.67	0.69	0.66	0.65	0.71	0.73	0.75	0.78	0.76	0.77	0.76	0.73	0.77	0.72
31.9	29.5	29.7	30.5	29.6	29.8	31.6	31.7	33.4	34.1	33.7	34.0	33.9	31.9	33.8	31.8
4.7	4.5	4.5	4.7	4.5	4.4	4.9	4.9	5.2	5.2	5.1	5.2	5.2	4.9	5.3	4.9
288	284	291	306	283	279	286	282	280	301	303	296	294	315	313	322
338	314	317	323	314	315	339	334	356	342	338	349	341	328	339	320

West Sugar4_H	West Sugar4_I	West Sugar4_J	West Sugar4_K	West Sugar4_L	West Sugar4_M	Cactus2_I	Cactus2_J	Cactus2_K	Cactus2_L	Cactus2_M	Cactus2_N	Cactus2_O	Cactus2_P	Cactus2_R	Cactus2_S
43.2	44.4	45.1	44.2	42.7	42.8	77.7	13.3	15.1	13.5	15.8	17.2	12.6	16.1	13.3	13.7
100.1	102.7	105.0	102.3	99.9	99.0	69.6	66.7	66.2	68.2	69.1	68.2	64.5	67.3	67.7	68.9
8.3	8.0	8.4	8.3	8.0	7.6	8.7	7.9	7.9	8.4	8.4	8.0	7.6	8.1	7.8	8.3
4.8	4.6	4.8	4.7	4.5	4.3	5.0	4.5	4.5	4.9	4.8	4.6	4.3	4.6	4.5	4.8
0.11	0.12	0.11	0.12	0.11	0.10	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.08	0.08
11719	11281	11270	11185	11115	10715	10051	9608	9727	9947	9709	10030	11202	10102	10035	9915
59.7	57.8	56.8	58.2	57.5	54.1	51.8	53.9	59.6	55.6	56.1	57.2	61.0	59.4	57.1	56.2
7.1	6.9	7.3	7.2	6.9	6.6	7.3	6.7	6.8	7.1	7.0	6.9	6.6	6.9	6.6	7.1
1.65	1.57	1.65	1.63	1.59	1.46	1.75	1.58	1.57	1.63	1.59	1.59	1.49	1.61	1.52	1.61
0.64	0.63	0.66	0.65	0.61	0.60	0.69	0.63	0.62	0.67	0.66	0.62	0.59	0.63	0.62	0.65
518	519	523	521	518	512	566	536	533	554	553	559	563	561	560	572
106	104	107	106	104	103	103	103	104	107	108	107	103	107	107	111
31.0	31.5	31.1	31.0	30.1	29.1	27.1	25.5	24.4	25.8	25.9	25.5	23.7	24.8	24.7	25.7
8.6	8.8	9.1	9.0	8.6	8.3	7.0	6.6	6.5	6.9	6.9	6.7	6.3	6.6	6.6	7.0
294	277	281	283	283	263	254	275	300	279	279	285	306	299	298	297
7.3	7.3	7.5	7.5	6.9	6.7	7.2	6.8	6.7	7.0	6.8	7.0	6.3	6.9	6.6	6.9
7.9	8.0	8.3	8.0	7.6	7.6	8.6	4.4	4.2	3.9	4.0	4.8	3.8	4.7	3.9	4.2
1.3	1.2	1.3	1.3	1.2	1.2	1.4	1.2	1.2	1.3	1.3	1.2	1.2	1.2	1.2	1.3
741	734	752	740	725	729	648	579	585	600	603	610	586	612	596	609
0.73	0.71	0.74	0.73	0.70	0.67	0.77	0.71	0.70	0.76	0.75	0.71	0.68	0.71	0.69	0.73
32.4	31.4	32.9	33.1	31.1	29.8	34.1	32.0	31.2	33.2	33.5	32.8	30.1	31.8	31.5	33.1
4.9	4.9	5.0	5.0	4.7	4.6	5.3	4.8	4.7	5.1	5.1	4.8	4.5	4.8	4.7	4.9
304	294	276	277	285	253	243	241	264	256	266	281	336	303	289	277
326	318	330	324	307	300	293	267	268	289	292	286	264	285	280	293

*All data in PPM

Appendix I cont.: Individual Sample Data from Laser Ablation Analysis.

Element	Shoshone_1	Shoshone_2	Shoshone_3	Rustler Rockshelter_1	Rustler Rockshelter_2	Rustler Rockshelter_3	Juan Source_1	Juan Source_2	Juan Source_3	MtHicks_1	MtHicks_2
Ba	808.4	778.5	817.4	8.8	8.6	9.1	51.6	52.3	51.9	87.8	85.6
Ce	136.0	133.9	130.1	172.4	163.4	164.7	107.2	111.3	107.1	87.7	85.8
Dy	4.3	4.0	3.8	10.6	9.8	10.1	3.4	3.4	3.5	1.9	1.9
Er	2.2	2.1	2.0	5.5	5.1	5.2	2.1	2.1	2.2	1.1	1.1
Eu	1.11	1.01	0.89	1.27	1.18	1.19	0.28	0.29	0.29	0.26	0.25
Fe	17957	18743	18178	13585	13559	13751	7373	7648	7371	6290	5847
Ga	66.6	71.3	63.5	58.8	60.4	59.0	41.4	41.1	43.4	43.6	45.7
Gd	5.0	4.8	4.6	12.1	11.2	11.4	3.4	3.3	3.4	2.1	2.0
Ho	0.81	0.77	0.70	1.99	1.83	1.83	0.68	0.65	0.71	0.37	0.37
Lu	0.32	0.30	0.28	0.69	0.63	0.63	0.37	0.37	0.39	0.20	0.20
Mn	1185	1115	1156	1733	1734	1754	961	997	946	780	755
Nb	41	39	39	90	88	89	73	73	74	44	44
Nd	40.3	39.1	36.9	63.7	59.1	60.2	25.5	25.9	25.5	19.2	19.1
Pr	12.2	11.9	11.5	17.2	16.2	16.4	8.7	9.0	8.7	6.7	6.6
Rb	179	206	184	204	210	206	228	229	243	191	197
Sm	6.8	6.4	6.5	13.8	13.2	13.4	4.2	4.3	4.5	2.8	2.6
Sr	156.8	81.0	94.3	1.2	1.1	1.2	14.6	14.4	14.3	33.9	33.5
Tb	0.7	0.7	0.7	1.8	1.7	1.7	0.5	0.5	0.6	0.3	0.3
Ti	1351	1319	1351	2644	2591	2659	1215	1272	1217	1169	1153
Tm	0.32	0.32	0.30	0.78	0.72	0.74	0.34	0.36	0.37	0.19	0.18
Y	14.9	14.3	14.2	36.9	34.5	35.2	14.7	14.7	15.2	8.0	8.1
Yb	2.2	2.1	2.0	5.1	4.6	4.7	2.5	2.6	2.7	1.3	1.4
Zn	291	316	282	479	503	478	145	146	145	164	169
Zr	295	283	284	923	860	886	242	245	249	220	215

Element	MtHicks_3	DryMt_1	DryMt_2	DryMt_3	Fish Springs_1	Fish Springs_2	Fish Springs_3	Bodie Hills_1	Bodie Hills_2	Bodie Hills_3
Ba	88.6	547.4	563.8	591.9	24.3	28.0	26.4	1028.9	1033.5	1001.3
Ce	87.8	130.9	131.6	142.2	50.2	52.2	52.5	99.5	96.5	95.5
Dy	1.9	4.1	4.1	4.5	5.0	5.3	5.1	1.6	1.5	1.6
Er	1.2	2.2	2.2	2.5	2.7	2.9	2.8	0.9	0.9	0.9
Eu	0.27	0.64	0.87	0.69	0.45	0.50	0.44	0.70	0.54	0.63
Fe	6101	12747	14245	12356	6702	6774	6413	10040	7881	8242
Ga	43.8	65.2	65.9	61.9	51.0	51.3	52.0	67.4	65.6	68.6
Gd	2.1	4.3	4.2	4.7	4.9	5.3	4.9	2.0	1.9	2.0
Ho	0.37	0.75	0.74	0.86	0.92	0.98	0.97	0.29	0.27	0.29
Lu	0.20	0.32	0.33	0.34	0.40	0.42	0.41	0.15	0.15	0.16
Mn	791	1158	1220	1142	1926	1951	1831	1018	923	957
Nb	45	67	66	69	94	97	94	34	33	33
Nd	19.3	33.3	33.7	37.4	20.8	21.1	20.9	22.0	21.1	22.2
Pr	6.8	10.9	10.9	11.8	5.3	5.5	5.6	7.9	7.6	7.5
Rb	194	186	188	190	241	251	253	231	237	236
Sm	2.9	5.6	5.4	5.9	5.4	5.7	5.7	2.8	2.9	3.1
Sr	33.6	123.8	131.5	136.4	9.7	10.4	10.2	139.8	141.8	139.5
Tb	0.3	0.7	0.7	0.7	0.8	0.9	0.8	0.3	0.3	0.3
Ti	1198	1766	1788	1835	879	882	893	1245	1283	1232
Tm	0.18	0.34	0.35	0.36	0.42	0.44	0.43	0.15	0.14	0.14
Y	8.2	14.8	15.1	16.9	19.3	20.2	19.8	6.3	6.2	6.3
Yb	1.3	2.4	2.4	2.5	3.0	3.0	3.0	1.1	1.0	1.1
Zn	157	262	267	232	246	248	250	237	205	226
Zr	220	376	385	407	229	240	238	239	243	245

*All data in PPM

Appendix I cont.: Individual Sample Data from Laser Ablation Analysis.

Element	WestCactus_A	WestCactus_B	WestCactus_C	WestCactus_D	WestCactus_E	WestCactus_F	WestCactus_G	WestCactus_H	WestCactus_I	WestCactus_J	EastSug_A	EastSug_B	EastSug_C	EastSug_D
Ba	4.0	5.1	4.6	5.0	5.9	5.5	5.5	5.8	5.1	5.6	25.5	26.5	23.9	18.6
Ce	65.3	70.7	70.4	72.5	69.3	86.2	83.4	83.7	79.9	78.2	72.2	74.7	71.5	56.0
Dy	10.4	12.2	12.8	12.6	12.7	16.4	15.4	15.9	15.4	14.2	7.7	8.2	7.6	6.4
Er	5.8	6.9	7.1	7.2	7.1	8.9	8.6	8.8	8.6	7.9	4.6	4.8	4.4	3.7
Eu	0.02	0.03	0.03	0.02	0.03	0.05	0.03	0.05	0.03	0.03	0.10	0.11	0.10	0.08
Fe	11802	12638	15347	11705	12572	16972	13672	18015	13304	13620	10895	10889	10850	8455
Ga	74.3	82.9	101.1	73.8	82.7	110.8	85.9	109.4	91.6	83.6	64.5	64.3	61.9	51.4
Gd	8.9	10.4	11.0	10.8	10.8	14.3	13.0	14.0	13.1	12.0	6.7	7.2	6.4	5.5
Ho	2.02	2.43	2.41	2.53	2.45	3.16	2.98	3.18	2.95	2.77	1.58	1.68	1.50	1.26
Lu	0.76	0.92	0.91	0.94	0.92	1.17	1.14	1.15	1.15	1.06	0.64	0.65	0.62	0.52
Mn	499	526	615	520	539	686	589	702	565	573	538	559	550	442
Nb	150	158	154	161	154	201	198	188	190	184	94	97	95	78
Nd	25.5	29.2	30.3	30.6	29.7	39.6	37.0	39.0	36.1	34.3	25.4	27.2	24.8	20.1
Pr	6.5	7.6	7.7	7.8	7.3	9.6	9.2	9.6	9.0	8.6	7.1	7.3	6.7	5.4
Rb	369	415	441	374	410	524	462	490	479	436	288	282	270	212
Sm	8.3	9.9	9.7	10.0	9.8	13.0	12.0	12.8	11.9	11.3	6.7	7.2	6.6	5.3
Sr	1.9	2.2	2.3	2.4	2.3	2.7	2.7	2.9	2.4	2.7	6.1	6.8	6.0	4.8
Tb	1.6	1.9	2.0	1.9	2.0	2.6	2.4	2.5	2.4	2.2	1.2	1.3	1.2	1.0
Ti	529	555	539	554	586	703	689	663	625	648	591	615	598	473
Tm	0.86	1.03	1.04	1.07	1.06	1.33	1.28	1.33	1.32	1.20	0.71	0.73	0.67	0.58
Y	39.7	46.4	47.4	48.3	48.0	62.7	60.1	61.4	59.3	54.7	31.2	32.9	30.1	25.8
Yb	5.8	6.9	6.8	7.1	7.0	8.8	8.6	8.8	8.5	8.0	4.8	4.9	4.5	3.8
Zn	437	505	685	427	502	452	332	521	423	369	331	325	303	258
Zr	278	323	311	345	336	412	421	401	401	372	299	315	286	244

Element	WestCactus_A	WestCactus_B	WestCactus_C	WestCactus_D	WestCactus_E	WestCactus_F	WestCactus_G	WestCactus_H	WestCactus_I	WestCactus_J	EastSug_A	EastSug_B	EastSug_C	EastSug_D
Ba	4.0	5.1	4.6	5.0	5.9	5.5	5.5	5.8	5.1	5.6	25.5	26.5	23.9	18.6
Ce	65.3	70.7	70.4	72.5	69.3	86.2	83.4	83.7	79.9	78.2	72.2	74.7	71.5	56.0
Dy	10.4	12.2	12.8	12.6	12.7	16.4	15.4	15.9	15.4	14.2	7.7	8.2	7.6	6.4
Er	5.8	6.9	7.1	7.2	7.1	8.9	8.6	8.8	8.6	7.9	4.6	4.8	4.4	3.7
Eu	0.02	0.03	0.03	0.02	0.03	0.05	0.03	0.05	0.03	0.03	0.10	0.11	0.10	0.08
Fe	11802	12638	15347	11705	12572	16972	13672	18015	13304	13620	10895	10889	10850	8455
Ga	74.3	82.9	101.1	73.8	82.7	110.8	85.9	109.4	91.6	83.6	64.5	64.3	61.9	51.4
Gd	8.9	10.4	11.0	10.8	10.8	14.3	13.0	14.0	13.1	12.0	6.7	7.2	6.4	5.5
Ho	2.02	2.43	2.41	2.53	2.45	3.16	2.98	3.18	2.95	2.77	1.58	1.68	1.50	1.26
Lu	0.76	0.92	0.91	0.94	0.92	1.17	1.14	1.15	1.15	1.06	0.64	0.65	0.62	0.52
Mn	499	526	615	520	539	686	589	702	565	573	538	559	550	442
Nb	150	158	154	161	154	201	198	188	190	184	94	97	95	78
Nd	25.5	29.2	30.3	30.6	29.7	39.6	37.0	39.0	36.1	34.3	25.4	27.2	24.8	20.1
Pr	6.5	7.6	7.7	7.8	7.3	9.6	9.2	9.6	9.0	8.6	7.1	7.3	6.7	5.4
Rb	369	415	441	374	410	524	462	490	479	436	288	282	270	212
Sm	8.3	9.9	9.7	10.0	9.8	13.0	12.0	12.8	11.9	11.3	6.7	7.2	6.6	5.3
Sr	1.9	2.2	2.3	2.4	2.3	2.7	2.7	2.9	2.4	2.7	6.1	6.8	6.0	4.8
Tb	1.6	1.9	2.0	1.9	2.0	2.6	2.4	2.5	2.4	2.2	1.2	1.3	1.2	1.0
Ti	529	555	539	554	586	703	689	663	625	648	591	615	598	473
Tm	0.86	1.03	1.04	1.07	1.06	1.33	1.28	1.33	1.32	1.20	0.71	0.73	0.67	0.58
Y	39.7	46.4	47.4	48.3	48.0	62.7	60.1	61.4	59.3	54.7	31.2	32.9	30.1	25.8
Yb	5.8	6.9	6.8	7.1	7.0	8.8	8.6	8.8	8.5	8.0	4.8	4.9	4.5	3.8
Zn	437	505	685	427	502	452	332	521	423	369	331	325	303	258
Zr	278	323	311	345	336	412	421	401	401	372	299	315	286	244

Appendix J: Individual Sample Data from ICP-MS analysis using microwave digestion

	WestSugar4-M	WestSugar1-O	WestSugar2-R	WestSugar3-I	SouthSugar1-L	SouthSugar2-L	SouthSugar3a-N	SouthSugar3b-I	JoshuaRidgeB-J	JoshuaRidge-O	*JoshuaRidge-R*	*JoshuaRidge-T*	*JoshuaRidgeB-L*
Ba	31.3	28.9	26.2	22.9	22.0	44.8	29.7	22.7	40.5	29.0	*45.5*	*30.0*	*30.5*
Ce	51.4	34.7	24.2	24.1	24.2	42.0	25.4	29.7	66.4	32.0	*78.9*	*46.1*	*53.3*
Dy	6.9	5.0	3.4	3.8	3.6	4.6	3.4	4.2	6.0	3.0	*7.2*	*6.8*	*7.2*
Er	4.7	3.3	2.2	2.4	2.3	2.9	2.1	2.7	3.8	1.8	*4.6*	*4.5*	*4.8*
Eu	0.20	0.10	0.06	0.07	0.08	0.10	0.08	0.07	0.17	0.08	*0.19*	*0.12*	*0.11*
Fe	8036	7264	6956	6694	6991	7920	7379	7105	6823	7573	*7736*	*5974*	*6416*
Ga	27.3	26.9	27.7	25.3	25.2	27.5	25.4	25.1	26.0	23.9	*25.8*	*25.1*	*26.4*
Gd	6.2	4.3	2.9	3.3	3.0	4.2	2.9	3.7	6.2	3.0	*7.6*	*5.8*	*6.4*
Ho	1.66	1.11	0.70	0.78	0.75	0.95	0.67	0.86	1.26	0.59	*1.54*	*1.47*	*1.53*
Lu	1.04	0.62	0.35	0.41	0.41	0.49	0.34	0.45	0.63	0.29	*0.75*	*0.76*	*0.79*
Mn	250	224	222	206	205	242	207	214	235	190	*244*	*232*	*241*
Nb	68.9	57.7	57.6	52.1	52.4	47.3	46.9	51.6	42.4	37.4	*44.3*	*50.6*	*54.7*
Nd	18.89	13.45	9.38	10.29	9.33	14.29	9.69	11.20	23.68	10.86	*28.64*	*18.24*	*20.42*
Pr	5.3	3.6	2.4	2.7	2.4	3.9	2.5	3.0	6.5	2.9	*8.1*	*4.9*	*5.4*
Rb	271	257	230	219	219	222	204	224	203	167	*204*	*244*	*261*
Si	49430	55204	27383	23748	20476	21175	19996	19090	28450	10464	*34033*	*37057*	*27612*
Sm	5.0	3.6	2.5	2.8	2.6	3.6	2.5	3.1	5.2	2.6	*6.2*	*4.7*	*5.2*
Sr	11.9	15.7	22.0	19.3	17.4	20.5	18.3	15.4	25.6	11.5	*25.6*	*24.4*	*24.7*
Tb	1.2	0.8	0.5	0.6	0.6	0.7	0.5	0.6	1.0	0.5	*1.2*	*1.0*	*1.1*
Ti	418	473	439	392	368	430	404	381	489	421	*547*	*408*	*430*
Tm	0.92	0.58	0.34	0.38	0.39	0.47	0.34	0.43	0.62	0.28	*0.74*	*0.74*	*0.76*
Y	30.4	17.5	11.4	12.9	11.7	16.6	10.9	15.3	26.9	9.8	*34.2*	*27.6*	*33.8*
Yb	5.3	3.9	2.6	2.8	2.8	3.4	2.4	3.3	4.1	2.1	*4.9*	*5.1*	*5.3*
Zn	57	58	57	52	52	55	53	56	58	51	*56*	*52*	*54*
Zr	214	207	258	226	226	251	231	228	252	227	*229*	*203*	*238*

** All data in PPM*

JoshuaRidgeR, JoshuaRidge-T, and JoshuaRidgeB-L (italicized), are Sugarloaf-identical samples from a nearby dome.

These samples were excluded from the sample averages found in Table 5.

Appendix J cont.: Individual Sample Data from ICP-MS analysis using microwave digestion

	SESugar1-O	SESugar1-V	SESugar2-L	SESugar2-F	SouthStewart-M	NorthStewart-J	SouthStewart-K	SouthStewart-L	Cactus1-J	Cactus1-L	Cactus2-T	BodieHills	Mt Hicks	Shoshone	GSD-1G pulv.	GSD-1G powder	Acid Blank
Ba	19.1	14.8	21.5	15.8	3.1	3.6	3.9	4.0	7.6	7.9	6.7	474.6	32.8	310.5	65.4	64.0	1.79
Ce	20.6	10.5	24.9	13.3	8.2	15.7	18.9	13.4	12.6	14.4	13.2	29.3	14.0	12.6	38.0	35.1	0.52
Dy	3.1	1.8	3.4	2.2	2.5	4.7	5.5	3.9	2.9	2.8	2.6	0.7	0.5	0.7	39.6	38.8	0.06
Er	2.0	1.1	2.2	1.4	1.5	3.0	3.4	2.4	1.8	1.8	1.7	0.5	0.3	0.4	26.3	26.3	0.03
Eu	0.07	0.04	0.06	0.04	0.05	0.02	0.03	0.03	0.05	0.05	0.04	0.30	0.09	0.16	34.16	32.76	0.04
Fe	6901	6406	6903	6539	6213	6405	6548	6547	5696	5522	5386	4004	3447	5085	87970	86600	97
Ga	24.1	22.9	24.4	23.6	26.2	26.8	27.6	28.2	22.9	22.8	22.6	45.7	17.1	33.1	56.5	56.2	0.24
Gd	2.6	1.4	2.9	1.8	2.0	3.7	4.2	3.1	2.2	2.4	2.1	1.3	0.7	0.8	41.4	39.3	0.08
Ho	0.64	0.35	0.70	0.44	0.52	0.98	1.09	0.81	0.60	0.57	0.54	0.14	0.12	0.15	35.30	35.27	0.03
Lu	0.36	0.20	0.38	0.23	0.27	0.50	0.55	0.41	0.32	0.31	0.29	0.10	0.09	0.09	30.48	31.04	0.03
Mn	185	164	199	173	160	192	199	196	212	206	205	373	285	310	209	208	0.45
Nb	50.1	49.3	46.6	46.5	71.0	70.1	69.4	71.5	45.8	60.4	59.0	16.3	21.5	17.3	46.1	44.1	0.20
Nd	8.29	4.54	9.27	5.61	4.31	8.28	9.49	6.80	6.01	6.22	5.68	7.61	3.67	3.70	39.48	36.52	0.25
Pr	2.1	1.1	2.3	1.4	1.0	1.9	2.1	1.6	1.4	1.5	1.3	2.3	1.2	1.0	38.8	36.1	0.08
Rb	205	194	213	198	242	260	269	262	190	188	188	158	123	124	18	20	0.16
Si	18182	18359	13405	17454	17893	18820	19121	20074	18533	25504	24480	18855	17465	19223	25581	28478	852
Sm	2.3	1.2	2.5	1.5	1.6	3.0	3.4	2.5	1.9	2.0	1.8	1.3	0.6	0.9	41.1	38.5	0.08
Sr	14.0	12.5	12.7	14.0	10.2	10.7	11.9	13.0	9.5	11.8	9.9	80.2	16.6	41.2	59.8	61.5	7.5
Tb	0.5	0.3	0.5	0.3	0.4	0.7	0.8	0.6	0.4	0.4	0.4	0.1	0.1	0.1	38.6	37.0	0.03
Ti	367	364	345	354	270	273	269	288	277	394	352	654	560	610	8108	7872	26
Tm	0.35	0.18	0.36	0.22	0.27	0.47	0.54	0.38	0.30	0.30	0.28	0.07	0.08	0.07	33.04	32.73	0.03
Y	10.2	5.4	11.6	6.8	7.4	15.5	17.0	12.5	9.0	9.6	8.8	2.8	1.6	2.2	20.3	21.3	0.11
Yb	2.4	1.4	2.6	1.7	1.8	3.5	3.9	2.9	2.2	2.2	2.1	0.6	0.4	0.5	31.9	32.0	0.03
Zn	49	47	49	47	57	59	60	62	46	46	45	31	31	34	111	110	-0.1
Zr	225	217	209	210	191	190	189	197	172	224	214	147	125	150	76	68	2.3

** All data in PPM*