United States
Environmental Protection
Agency

Environmental Research
Laboratory
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EPA-600/4-79-017
March 1979

Research and Development

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Inductively Coupled Plasma-Atomic Emission Spectroscopy

Prominent Lines

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EPA-600/4-79-017
March 1979

INDUCTIVELY COUPLED PLASMA - ATOMIC EMISSION SPECTROSCOPY: PROMINENT LINES

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Interagency Agreement No. EPA-IAG-78-D-X0146

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FOREWORD

Nearly every phase of environmental protection depends on a capability to identify and measure specific pollutants in the environment. As part of this Laboratory's research on the occurrence, movement, transformation, impact, and control of environmental contaminants, the Analytical Chemistry Branch develops and assesses new techniques for identifying and measuring chemical constituents of water and soil.

The use of inductively coupled plasma (ICP)-atomic emission spectroscopy is expected to increase rapidly as analytical chemists confront new problems in elemental characterization. This report records the prominent lines of the ICP emission spectra of some 70 elements as the first step in the development of a spectral atlas that would serve as a useful tool in the selection of analytical lines for this spectroscopic technique.

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PREFACE

An analytical facility, employing inductively coupled plasma, atomic emission spectroscopy (ICP-AES), is being developed for the rapid and comprehensive qualitative and quantitative survey of the chemical elements in water. Because many of the elements of interest in water are present at trace or ultratrace levels we needed tc know the "ultimate" line (yielding the lowest detection limit) for each element as well as alternate lines in the event the ultimate line proved to be unsuitable for a particular analytical problem. When this project was undertaken, little information was available on the relative intensities of spectral lines emitted by the ICP. With the available time and resources we could not produce the ICP equivalent of the MIT or NBS wavelength tables. We did, however, develop a relatively simple and rapid method for estimating the analytical capabilities of the prominent lines emitted by 70 metallic and metalloid elements. The resulting data, contained in this report, are therefore a necessary prerequisite for the development of an elemental survey instrument based on ICP-AES.

ABSTRACT

The prominent lines of 70 elements as emitted in an inductively coupled plasma excitation source have been identified. The lines are listed alphabetically by element and numerically by wavelength. Detection limit capabilities are estimated for each spectral line.

This report was submitted in fulfillment of Interagency Agreement IAG-EPA-78-D-X0146 by the Ames Laboratory under the sponsorship of the U.S. Environmental Protection Agency. This report covers the period from March 1, 1977, to February 28, 1978, and work was completed as of August 17, 1978.

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LIST OF ABBREVIATIONS AND SYMBOLS

AES	--	atomic emission spectroscopy
AMPS	--	amperes
C	--	concentration
DL	--	detection limit
I_b	--	background intensity
ICP	--	inductively coupled plasma
I_g	--	gross intensity
I_n	--	net intensity
L/min	--	liters per minute
m	--	meter
mg/L	--	milligram per liter
mL/min	--	milliliter per minute
mm	--	millimeter
nm	--	nanometer
W	--	watt

ACKNOWLEDGMENT

The authors gratefully acknowledge the help of M. A. Floyd in the computer listing of the spectral lines and the related numerical data.

SECTION 1

INTRODUCTION

A comprehensive listing of spectral lines with appropriate intensity information is an invaluable aid in the development of spectroscopic analytical methods. The existing wavelength tables (1-6) have been excellent sources for the identification of spectral lines and for interpretation of spectra in arc, spark and flame atomic spectroscopy. For many elements, the relative intensities exhibited by the spectra excited in the inductively coupled plasma (ICP) do not correspond to the information available in the published wavelength tables. A typical example is shown in Table I. These data show that the Mg II line intensities are much stronger, relative to the Mg I line intensities, in the ICP than in arc and spark excitation sources. Because of these relative intensity disparities, an atlas of the spectra of all elements as observed in the emissions from ICPs would serve as a useful guide in the selection of analytical lines for ICP-atomic emission spectroscopy (AES). As an initial step in the preparation of such an atlas, we have recorded the ICP emission spectra of some 70 elements over a wavelength range of ∿320 nm that covers the prominent lines. Publication of an atlas of these recordings is the eventual goal, but in view of the rapid anticipated growth of ICP-atomic emission spectroscopy to new analytical problems (7), the rapid publication of a definitive list of the prominent lines compiled from these records is highly desirable. We use the term prominent* line because we have chosen to express the line strengths in terms of net signal-to-background ratios and estimated detection limits. For analytical purposes these quantities are far more useful than relative intensities. Also the use of net signal-to-background ratios eliminates the need for consideration of photomultiplier sensitivity and grating efficiency as functions of wavelength. When possible, ten or more of the prominent lines of each element are listed. Some elements, e.g. boron and carbon, emit fewer than ten lines of measurable intensity in the ICP under the operating conditions used in this study.

* Prominent denotes "standing out so as to be easily seen," standing out beyond the adjacent surface or line" (8).

Table I. Comparison of relative intensities of spectral lines of Mg obtained from arc, spark, and inductively coupled plasma excitation sources. The relative intensities have all been normalized with respect to those of the Mg I 383.83 nm line.

	Ionization State and Wavelengths (nm)			
	(II) 279.55	(II) 280.27	(I) 285.21	(I) 383.83
NBS (1) Cu-arc	2	1.2	12	1
MIT (2) arc	0.5	0.5	1	1
MIT (2) spark	1.5	1.5	0.5	1
AL* ICP	80	42	8	1

*Ames Laboratory

SECTION 2

CONCLUSIONS AND RECOMMENDATIONS

Relative intensities of spectral lines excited in the ICP may differ considerably from those obtained from other types of excitation sources.

Trace element analytical capabilities of spectral lines can be compared rapidly and in a simple manner from signal/background ratios which may be read directly from wavelength scans made with a logarithmic intensity scale.

A comprehensive listing of observed spectral line interferences would be a useful complement to the prominent line information listed in this report.

SECTION 3

EXPERIMENTAL FACILITIES AND PROCEDURES

The experimental facilities and operating conditions are shown in Table II. The wavelength scans for all elements were obtained under a single set of operating conditions. The information generated from these scans is therefore applicable to simultaneous multielement ICP methods.

A four decade recording range, made possible by a logarithmic current/voltage converter, allowed the intensity from the full 189-516 nm range (189-590 nm for sodium) to be recorded without changes in recorder or amplifier settings, thus considerably simplifying the collection of the data and its interpretation. For example, the logarithmic intensity scale allows a simple method to be used for the estimation of detection limits directly from the wavelength recordings.

On a logarithmic scale the separation of two values corresponds to the log of the ratio of the values rather than the absolute difference as would be indicated on a linear scale. The difference, therefore, between a peak intensity (gross intensity I_g) and its background intensity I_b on a log scale may be written:

$$\log I_g - \log I_b = \log \frac{I_g}{I_b} \qquad (1)$$

The gross intensity I_g is the sum of I_b and the net analyte intensity I_n, therefore Equation 1 may be rewritten:

$$\log I_g - \log I_b = \log \left(\frac{I_n + I_b}{I_b}\right) \qquad (2)$$

$$= \log \left(\frac{I_n}{I_b} + 1\right) \qquad (3)$$

Now, if a log scale (scaled the same as the recording scale) is laid beside a spectral line, with unity corresponding to the background level, the antilog values on the scale will correspond to the quantity $(I_n/I_b + 1)$ as shown at the left of the Zn 213.86 nm

Table II. Experimental facilities and operating conditions.

Monochromator	Jarrell-Ash Model No. 78-466 1 m focal length; 1180 grooves/mm grating; blazed for 250 nm; 20 micrometer entrance and exit slits
Plasma	Plasma-Therm
HF generator	Model HFS-2500D
power	1100 W
plasma Ar flowrate*	20 L/min
auxiliary plasma Ar flowrate*	flow is turned off for normal operation, ∿1 L/min is used for starting plasma
vertical observation zone	12-18 mm above load coil
Nebulizer	Pneumatic cross-flow type
sample uptake rate	1.9 mL/min
aerosol carrier Ar flowrate*	1 L/min
Data acquisition system	Logarithmic current/voltage converter to Hewlett-Packard 7001AM X-Y recorder

* Nomenclature for the ICP gas flows has been defined in references 9 and 10.

peak in Figure 1. The I_n/I_b ratio can be read directly if the antilog values on the log scale are adjusted by the factor of one as shown at the right of the Zn 213.86 nm peak in Figure 1. With such a "reading scale", the I_n/I_b ratio can be read directly and rapidly for any spectral line on the recording.

The detection limit (DL), in its conventional sense, is defined as the analyte concentration required to yield a net signal equivalent to three times the standard deviation of the background beneath the spectral line (11). Under normal operating conditions, with all components in the signal processing system operating properly, the uncertainty (standard deviation) in the spectral background usually lies within the range of 0.3 - 1.0% of the background signal level. This agrees

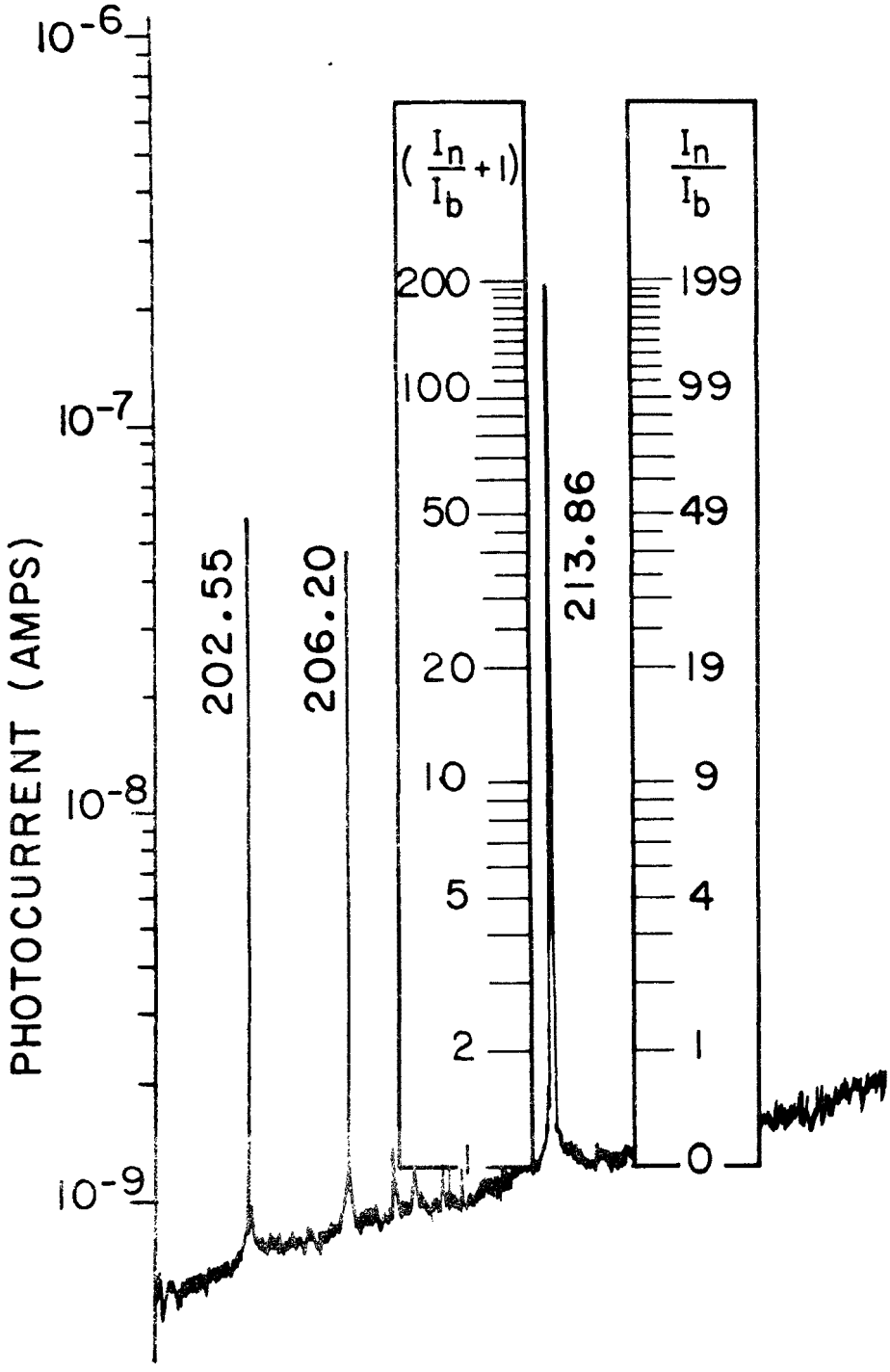

Figure 1. Signal-to-background ratios (I_n/I_b) of spectral lines can be read directly from log-scaled intensities with appropriately numbered scales. The scales in this figure are superimposed on a portion of the Zn spectrum. Please see text for an explanation of the scales.

essentially with the findings of Boumans and DeBoer (10,12), and for our polychromator system (13) applies generally to all analytical lines regardless of wavelength. Therefore, the standard deviation of the background can be approximated by 0.01 I_b and the detection limits can be estimated from

$$DL \approx \frac{3(0.01\ I_b)C}{I_n} \tag{4}$$

$$\approx \frac{0.03\ C}{I_n/I_b} \tag{5}$$

in which C is the analyte concentration which yielded I_n/I_b. The analyte concentrations used for the wavelength scans were chosen so that the maximum I_n/I_b ratio for each element fell within the approximate range of 20-200. The I_n/I_b ratios of the most prominent lines of each element were measured with the log scale described above. These ratios, the elemental concentrations, and the appropriate spectral line information were transferred to computer memory from which the information was retrieved alphabetically by element and serially in order of wavelength. The estimated detection limits were computed from Equation 5 and were printed with the alphabetical and serial line listings.

SECTION 4

RESULTS AND DISCUSSION

The prominent lines for each element are listed in Appendix A alphabetically by element and in order of decreasing I_n/I_b ratio for each element group. These same spectral lines are listed in order of wavelength in Appendix B. Information on all lines of argon and hydrogen which appeared in the background and elemental scans with measurable I_n/I_b ratios is also included in the tables.

Because the detection limits listed in Appendices A and B were estimated from I_n/I_b ratios, an inquiry is appropirate into how these detection limits compare with those obtained in the conventional manner (11). The comparison provided in Figure 2 shows that the two methods agree moderately well, especially when the uncertainties in the detection limits determined by either method are considered. Detection limits are inherently rather imprecise numbers.

The data in Figure 2 suggests that the I_n/I_b based detection limits are conservative estimates. The scatter of the points would not change but the correlation of the two methods would be closer to 1:1 if 0.7% rather than 1.0% had been used for the estimated relative standard deviation of the background signals. The significance of the comparison of detection limits is, however, that the trace element analytical capabilities of spectral lines can be compared rapidly and in a simple manner, as described in this paper, from wavelength scans made with a logarithmic intensity scale.

Our emphasis on line strength, line-to-background ratios, and detection limits is that these criteria are primary figures of merit for trace and ultratrace analytical applications. Once the sensitive lines are identified, then other important criteria must be considered. These criteria include: 1) freedom from spectral line interferences arising from sample concomitants or from the supporting atmosphere of the discharge, 2) linearity of response of the spectral lines with concentrations, 3) low stray light contributions at the analytical line wavelengths, and 4) spatial accessibility in polychromators. With reference to the latter, the wavelength distribution of the lines listed in Appendices A and B confirm our earlier findings that many of the prominent lines emitted in the ICP are located in the region

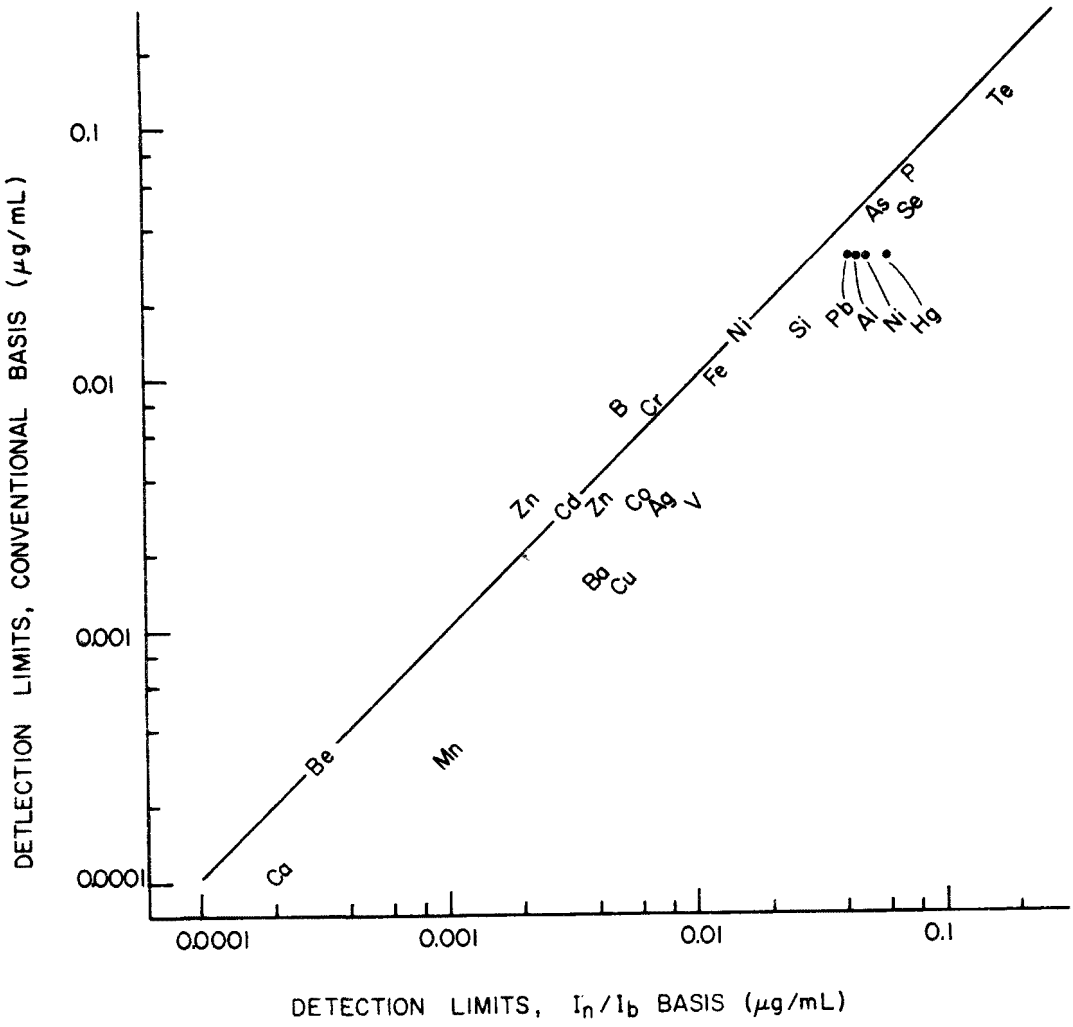

Figure 2. Comparison of detection limits calculated in the conventional manner (analyte concentration equivalent to threetimes the standard deviation of I_b) with those calculated from the assumption that the standard deviation of I_b can be approximated by 0.01 I_b.

near 200 nm. For example, 35% of all the metallic and metalloid element lines in Appendices A and B are located below 250 nm. If only the line of highest I_n/I_b is considered for each element then approximately 45% occur in the region below 250 nm. This high number density of potentially useful analytical lines in the low wavelength region may therefore present problems in the selection of lines for polychromator systems. The problem arises because each analytical wavelength requires a fixed space for the slit assembly, mirror, and photomultiplier. Compromises have to be made when two desired analytical wavelengths compete for the same component space. Because most elements possess alternative lines with approximately equivalent detection limits, these compromises can usually be accommodated without serious loss of powers of detection.

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PREFACE TO APPENDICES A AND B, EXPLANATION OF SYMBOLS AND ABBREVIATIONS

S of I — State of Ionization. The symbols I, 'II, and III indicate that the spectral lines originate respectively from the neutral atom, single ionized and doubly ionized states.

I_n/I_b — Ratio of net analyte intensity to background intensity.

CONC — Concentration of the single element analyte solution used for the wavelength scans from which the prominent lines were determined.

EST'D DET LIM — Estimated Detection Limit. Detection limits estimated from the I_n/I_b ratios as explained in this paper.

NM — Not Measurable because of interfering line listed in COMMENTS column.

COMMENTS — All wavelengths listed in Appendices A and B were taken from the NBS tables (1) unless otherwise designated in the comments column. Either air or vacuum wavelengths are listed depending on the source.

Air Wavelengths	Vacuum Wavelengths
NBS (1)	NRL (4)
MIT (2)	UCRL (5)
Zaidel, 200 nm and above (3)	Zaidel, below 200 nm (3)

NR — Not Resolved. This description indicates components of an unresolved pair of lines. For convenience in the computer listing of the data, I_n/I_b, CONC, and EST'D DET LIM values are listed for each wavelength although only a single I_n/I_b measurement was obtained from each unresolved pair.

GROUP NR — This description indicates components of an unresolved group (3 or more lines). Only the wavelength of the strongest line (NBS tables (1)) is listed.

APPROX WAVE — Approximate Wavelength. This description applies to spectral lines (Os, Pt) which have not been positively identified as belonging to the elemental scans in which they were found. These approximate wavelengths may be previously unreported lines of Os and Pt or they may be due to impurities. The impurities, if present, have not been positively identified.

Additional remarks

Significant figures. Although the number of digits shown in the EST'D DET LIM column may be greater than the precision of the determination justifies, no convenient means of limiting the number of significant digits in the computer printout was available. Normally, only one significant figure is appropriate for detection limit data (11).

Interferences. The comments column includes interference information when a component of the background spectrum overlaps an analyte line (e.g., the Dy 396.839 nm line is located on the broad H 397.007 nm line) or when an analyte line is located in a complex molecular band system (e.g., the OH 306.36 nm system) where band components may cause spectral interferences. The notation of molecular bands does not preclude the use of analyte wavelengths within the band region; e.g. with our experimental facilities the Al 308.22, Be 313.04, Ca 315.89 and Cu 324.75 nm lines are analytically useful even though they are located in the OH band region.

Argon lines. Most of the argon lines above 475 nm in Appendices A and B exhibit considerable broadening which may be due to broadened upper energy levels of the associated transitions. The upper energy levels of these broad lines lie near the ionization energy of the argon atom.

APPENDIX A

Prominent Lines of the Elements Emitted by the Inductively Coupled Plasma Alphabetical list with the lines of each element listed in order of decreasing I_n/I_b ratio.

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Ag	I	328.068	38.0	10.0	0.007	
Ag	I	338.289	23.0	10.0	0.013	
Ag	II	243.779	2.5	10.0	0.120	
Ag	II	224.641	2.3	10.0	0.130	Zaidel
Ag	II	241.318	1.5	10.0	0.200	
Ag	II	211.383	0.9	10.0	0.333	Zaidel
Ag	II	232.505	0.7	10.0	0.428	Zaidel
Ag	II	224.874	0.6	10.0	0.500	Zaidel
Ag	II	233.137	0.5	10.0	0.600	
Al	I	309.271	13.0	10.0	0.023	OH Band
Al	I	309.284	13.0	10.0	0.023	OH Band
Al	I	396.152	10.5	10.0	0.028	
Al	I	237.335	10.0	10.0	0.030	NR
Al	I	237.312	10.0	10.0	0.030	NR
Al	I	226.922	9.0	10.0	0.033	NR
Al	I	226.910	9.0	10.0	0.033	NR
Al	I	308.215	6.6	10.0	0.045	OH Band
Al	I	394.401	6.3	10.0	0.047	
Al	I	236.705	5.8	10.0	0.051	
Al	I	226.346	5.0	10.0	0.060	Zaidel
Al	I	221.006	4.8	10.0	0.062	Zaidel
Al	I	257.510	4.0	10.0	0.075	
Ar	I	415.859	>50.0			Zaidel
Ar	I	419.832	50.0			Zaidel
Ar	I	420.068	50.0			Zaidel
Ar	I	425.936	50.0			Zaidel
Ar	I	427.217	43.0			Zaidel
Ar	I	430.010	40.0			Zaidel
Ar	I	433.356	38.0			Zaidel
Ar	I	560.673	36.0			Zaidel
Ar	I	555.870	33.0			Zaidel
Ar	I	426.629	32.0			Zaidel
Ar	I	419.103	32.0			Zaidel,NR
Ar	I	419.071	32.0			Zaidel,NR
Ar	I	404.442	31.0			Zaidel
Ar	I	549.587	31.0			Zaidel
Ar	I	418.188	28.0			Zaidel

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Ar	I	394.898	27.0			Zaidel
Ar	I	588.859	25.0			Zaidel
Ar	I	518.775	24.0			Zaidel
Ar	I	451.074	21.0			Zaidel
Ar	I	565.070	21.0			Zaidel
Ar	I	557.255	21.0			Zaidel
Ar	I	591.200	19.0			Zaidel
Ar	I	355.431	18.0			Zaidel
Ar	I	516.228	18.0			Zaidel
Ar	I	416.418	17.0			Zaidel
Ar	I	545.165	15.0			Zaidel
Ar	I	573.952	15.0			Zaidel
Ar	I	433.534	11.0			Zaidel
Ar	I	592.881	10.0			Zaidel
Ar	I	434.517	9.0			Zaidel
Ar	I	522.127	9.0			Zaidel
Ar	I	360.652	8.7			Zaidel
Ar	I	356.766	8.6			Zaidel
Ar	I	394.750	8.0			Zaidel
Ar	I	425.119	7.5			Zaidel
Ar	I	470.232	7.2			Zaidel
Ar	I	588.263	7.1			Zaidel
Ar	I	364.983	7.0			Zaidel
Ar	I	542.135	6.6			Zaidel
Ar	I	452.232	6.2			Zaidel
Ar	I	583.426	6.0			Zaidel
Ar	I	383.468	6.0			Zaidel
Ar	I	515.140	6.0			Zaidel
Ar	I	550.611	6.0			Zaidel
Ar	I	459.610	6.0			Zaidel
Ar	I	552.496	5.0			Zaidel
Ar	I	555.962	4.9			Zaidel
Ar	I	586.032	4.3			Zaidel
Ar	I	462.844	4.0			Zaidel
Ar	I	577.212	4.0			Zaidel
Ar	I	363.446	3.9			Zaidel
Ar	I	559.748	3.9			Zaidel
Ar	I	525.279	3.8			Zaidel
Ar	I	339.375	3.6			Zaidel
Ar	I	558.872	3.5			Zaidel
Ar	I	363.268	3.5			Zaidel
Ar	I	346.108	3.5			Zaidel
Ar	I	356.329	3.2			Zaidel
Ar	I	487.626	3.2			Zaidel
Ar	I	488.795	3.2			Zaidel
Ar		436.836	3.2			MIT

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Ar	I	525.448	3.2			Zaidel
Ar	I	331.935	3.1			Zaidel
Ar	I	545.742	2.8			Zaidel
Ar	I	580.208	2.8			Zaidel
Ar	I	568.190	2.8			Zaidel
Ar	I	511.820	2.8			Zaidel
Ar	I	506.008	2.7			Zaidel
Ar	I	594.267	2.7			Zaidel
Ar	I	504.881	2.6			Zaidel
Ar	I	544.222	2.5			Zaidel
Ar	I	404.597	2.5			Zaidel
Ar	I	565.913	2.4			Zaidel
Ar	I	367.067	2.4			Zaidel
Ar	I	357.229	2.3			Zaidel
Ar	I	547.346	2.3			Zaidel
Ar	I	543.999	2.2			Zaidel
Ar	I	356.434	2.1			Zaidel
Ar	I	369.090	2.0			Zaidel
Ar	I	377.037	2.0			Zaidel
Ar	I	350.649	2.0			Zaidel
Ar	I	568.964	2.0			Zaidel
Ar	I	568.991	2.0			Zaidel
Ar	I	517.754	1.9			Zaidel
Ar	I	339.278	1.8			Zaidel
Ar	I	337.348	1.8			Zaidel
Ar	I	355.601	1.7			Zaidel
Ar	I	505.418	1.7			Zaidel
Ar	I	564.866	1.7			Zaidel
Ar	I	340.618	1.6			Zaidel
Ar	I	405.453	1.5			Zaidel
Ar	I	364.312	1.5			Zaidel
Ar	I	489.469	1.5			Zaidel
Ar	I	541.047	1.4			Zaidel
Ar	I	561.797	1.4			Zaidel
Ar	I	365.953	1.4			Zaidel
Ar	I	389.466	1.4			Zaidel
Ar	I	317.296	1.4			OH Band,Zaidel
Ar	I	537.349	1.4			Zaidel
Ar	I	378.136	1.3			Zaidel
Ar	I	367.524	1.1			Zaidel
Ar	I	332.550	1.1			Zaidel
Ar	I	389.986	1.0			Zaidel
Ar	I	436.379	1.0			Zaidel
Ar	I	562.089	1.0			Zaidel
Ar	I	564.134	1.0			Zaidel
Ar	I	475.294	1.0			Zaidel

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Ar	I	476.867	0.9			Zaidel
Ar	I	560.108	0.9			Zaidel
Ar	I	563.558	0.9			Zaidel
Ar	I	349.327	0.9			Zaidel
Ar	I	558.183	0.8			Zaidel
Ar	I	320.039	0.8			OH Band,Zaidel
Ar	I	528.608	0.8			Zaidel
Ar	I	495.675	0.8			Zaidel
Ar	I	323.449	0.8			OH Band,Zaidel
Ar	I	553.445	0.7			Zaidel
Ar	I	570.086	0.7			Zaidel
Ar	I	325.758	0.7			Zaidel
Ar	I	539.397	0.7			Zaidel
Ar	I	483.669	0.6			Zaidel
Ar	I	507.308	0.6			Zaidel
Ar	I	508.709	0.6			Zaidel
Ar	I	521.049	0.5			Zaidel
Ar	I	531.773	0.5			Zaidel
Ar	I	563.911	0.5			Zaidel
Ar	I	503.203	0.5			Zaidel
Ar	I	524.110	0.5			Zaidel
Ar	I	512.780	0.5			Zaidel
Ar	I	442.399	0.5			Zaidel
Ar	I	562.378	0.4			Zaidel
Ar	I	521.477	0.3			Zaidel
Ar	I	534.741	0.3			Zaidel
Ar	I	498.995	0.2			Zaidel
Ar	I	458.929	0.2			Zaidel
As	I	193.696	56.0	100.0	0.053	
As	I	197.197	39.0	100.0	0.076	
As	I	228.812	36.0	100.0	0.083	
As	I	200.334	25.0	100.0	0.120	
As	I	189.042	22.0	100.0	0.136	NRL
As	I	234.984	21.0	100.0	0.142	
As	I	198.970	16.0	100.0	0.187	
As	I	200.919	6.1	100.0	0.491	
As	I	278.022	5.7	100.0	0.526	
As	I	199.048	5.5	100.0	0.545	
Au	I	242.795	170.0	100.0	0.017	
Au	I	267.595	96.0	100.0	0.031	
Au	I	197.819	77.0	100.0	0.038	Zaidel
Au	II	208.209	70.0	100.0	0.042	Zaidel

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Au	I	201.200	54.0	100.0	0.055	
Au	II	211.068	47.0	100.0	0.063	Zaidel
Au	I	191.893	35.0	100.0	0.085	Zaidel
Au	II	200.081	32.0	100.0	0.093	Zaidel
Au	II	198.963	20.0	100.0	0.150	Zaidel
Au	I	195.193	18.0	100.0	0.166	Zaidel
B	I	249.773	63.0	10.0	0.0048	
B	I	249.678	53.0	10.0	0.0057	
B	I	208.959	30.0	10.0	0.010	
B	I	208.893	25.0	10.0	0.012	
Ba	II	455.403	230.0	10.0	0.0013	
Ba	II	493.409	130.0	10.0	0.0023	
Ba	II	233.527	75.0	10.0	0.0040	
Ba	II	230.424	73.0	10.0	0.0041	
Ba	II	413.066	9.1	10.0	0.032	
Ba	II	234.758	7.8	10.0	0.038	
Ba	II	389.178	5.2	10.0	0.057	H 388.905
Ba	II	489.997	3.7	10.0	0.081	
Ba	II	225.473	2.0	10.0	0.150	Zaidel
Ba	II	452.493	1.9	10.0	0.157	
Be	II	313.042	110.0	1.0	0.00027	OH Band
Be	I	234.861	96.0	1.0	0.00031	
Be	II	313.107	41.0	1.0	0.00073	OH Band
Be	I	249.473	8.0	1.0	0.0038	Group NR
Be	I	265.045	6.4	1.0	0.0047	Group NR
Be	I	217.510	2.5	1.0	0.012	NR
Be	I	217.499	2.5	1.0	0.012	NR
Be	I	332.134	1.4	1.0	0.021	Group NR
Be	I	205.590	0.7	1.0	0.042	Zaidel,NR
Be	I	205.601	0.7	1.0	0.042	Zaidel,NR
Bi	I	223.061	87.0	100.0	0.034	
Bi	I	306.772	40.0	100.0	0.075	OH Band
Bi	I	222.825	36.0	100.0	0.083	
Bi	I	206.170	35.0	100.0	0.085	
Bi	I	195.389	14.0	100.0	0.214	
Bi	I	227.658	12.0	100.0	0.250	
Bi	II	190.241	10.0	100.0	0.300	Zaidel
Bi	I	213.363	10.0	100.0	0.300	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Bi	I	289.798	9.0	100.0	0.333	
Bi	I	211.026	7.8	100.0	0.384	
C	I	193.091	67.0	100.0	0.044	NRL
C	I	247.856	17.0	100.0	0.176	
C	I	199.362	3.4	1000.0	8.823	NRL
Ca	II	393.366	89.0	0.5	0.00019	
Ca	II	396.847	30.0	0.5	0.00050	H 397.007
Ca	II	317.933	1.5	0.5	0.010	OH Band
Ca	I	422.673	1.5	0.5	0.010	
Cd	II	214.438	120.0	10.0	0.0025	
Cd	I	228.802	110.0	10.0	0.0027	
Cd	II	226.502	89.0	10.0	0.0034	
Cd	I	361.051	1.3	10.0	0.230	
Cd	I	326.106	0.9	10.0	0.333	
Cd	I	346.620	0.7	10.0	0.428	
Cd	I	231.284	0.5	10.0	0.600	
Cd	I	479.992	0.5	10.0	0.600	
Ce	II	413.765	6.2	10.0	0.048	
Ce	II	413.380	6.0	10.0	0.050	
Ce	II	418.660	5.7	10.0	0.052	
Ce	II	393.109	5.0	10.0	0.060	
Ce	II	446.021	4.8	10.0	0.062	
Ce	II	394.275	4.4	10.0	0.068	
Ce	II	429.667	4.3	10.0	0.069	
Ce	II	407.585	4.2	10.0	0.071	NR
Ce	II	407.571	4.2	10.0	0.071	NR
Ce	II	456.236	4.1	10.0	0.073	
Ce	II	404.076	4.0	10.0	0.075	
Ce	II	380.152	4.0	10.0	0.075	
Ce	II	401.239	4.0	10.0	0.075	
Co	II	238.892	50.0	10.0	0.0060	
Co	II	228.616	43.0	10.0	0.0070	
Co	II	237.862	31.0	10.0	0.0097	
Co	II	230.786	31.0	10.0	0.0097	
Co	II	236.379	27.0	10.0	0.011	
Co	II	231.160	23.0	10.0	0.013	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Co	II	238.346	21.0	10.0	0.014	
Co	II	231.405	18.0	10.0	0.016	
Co	II	235.342	17.0	10.0	0.017	
Co	II	238.636	14.0	10.0	0.021	
Co	II	234.426	14.0	10.0	0.021	
Co	II	231.498	13.0	10.0	0.023	
Co	II	234.739	13.0	10.0	0.023	
Cr	II	205.552	49.0	10.0	0.0061	
Cr	II	206.149	42.0	10.0	0.0071	
Cr	II	267.716	42.0	10.0	0.0071	
Cr	II	283.563	42.0	10.0	0.0071	
Cr	II	284.325	35.0	10.0	0.0086	
Cr	II	206.542	31.0	10.0	0.0097	
Cr	II	276.654	22.0	10.0	0.013	
Cr	II	284.984	21.0	10.0	0.014	
Cr	II	285.568	16.0	10.0	0.018	
Cr	II	276.259	15.0	10.0	0.020	
Cr	II	286.257	15.0	10.0	0.020	
Cr	II	266.602	14.0	10.0	0.021	
Cr	II	286.511	14.0	10.0	0.021	
Cr	II	286.674	13.0	10.0	0.023	
Cr	II	357.869	13.0	10.0	0.023	
Cs	II	452.673	0.7	1000.0	42.857	Zaidel
Cs	I	455.531	0.3	1000.0	100.000	
Cu	I	324.754	56.0	10.0	0.0054	OH Band
Cu	II	224.700	39.0	10.0	0.0077	
Cu	I	219.958	31.0	10.0	0.0097	
Cu	I	327.396	31.0	10.0	0.0097	
Cu	II	213.598	25.0	10.0	0.012	
Cu	I	223.008	23.0	10.0	0.013	
Cu	I	222.778	19.0	10.0	0.015	
Cu	II	221.810	17.0	10.0	0.017	Zaidel
Cu	II	219.226	17.0	10.0	0.017	
Cu	I	217.894	17.0	10.0	0.017	
Cu	I	221.458	13.0	10.0	0.023	
Dy	II	353.170	30.0	10.0	0.010	
Dy	II	364.540	13.0	10.0	0.023	
Dy	II	340.780	11.0	10.0	0.027	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Dy	II	353.602	10.0	10.0	0.030	
Dy	II	394.468	9.5	10.0	0.031	
Dy	II	396.839	9.5	10.0	0.031	Ca 396.847,H 397.007
Dy	II	338.502	9.0	10.0	0.033	
Dy	II	400.045	8.4	10.0	0.035	
Dy	II	387.211	8.2	10.0	0.036	
Dy	II	407.796	7.5	10.0	0.040	
Dy	II	352.398	7.4	10.0	0.040	
Dy	II	353.862	6.6	10.0	0.045	
Dy	II	357.624	6.4	10.0	0.046	
Dy	II	389.853	6.0	10.0	0.050	
Dy	II	238.736	5.8	10.0	0.051	
Er	II	337.271	29.0	10.0	0.010	
Er	II	349.910	17.0	10.0	0.017	
Er	II	323.058	16.0	10.0	0.018	OH Band
Er	II	326.478	16.0	10.0	0.018	
Er	II	369.265	16.0	10.0	0.018	
Er	II	390.631	14.0	10.0	0.021	
Er	II	291.036	11.0	10.0	0.027	
Er	II	296.452	11.0	10.0	0.027	
Er	II	331.242	10.0	10.0	0.030	
Er	II	339.200	9.4	10.0	0.031	
Er	II	338.508	8.8	10.0	0.034	
Er	II	389.623	7.0	10.0	0.042	H 388.905
Eu	II	381.967	110.0	10.0	0.0027	
Eu	II	412.970	70.0	10.0	0.0043	
Eu	II	420.505	70.0	10.0	0.0043	
Eu	II	393.048	53.0	10.0	0.0057	
Eu	II	390.710	39.0	10.0	0.0077	
Eu	II	272.778	37.0	10.0	0.0081	
Eu	II	372.494	34.0	10.0	0.0088	
Eu	II	397.196	32.0	10.0	0.0094	H 397.007
Eu	II	443.556	24.0	10.0	0.012	
Eu	II	281.394	22.0	10.0	0.013	
Fe	II	238.204	65.0	10.0	0.0046	
Fe	II	239.562	59.0	10.0	0.0051	
Fe	II	259.940	48.0	10.0	0.0062	
Fe	II	234.349	29.0	10.0	0.010	
Fe	II	240.488	27.0	10.0	0.011	
Fe	II	259.837	24.0	10.0	0.012	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Fe	II	261.187	24.0	10.0	0.012	
Fe	II	234.810	23.0	10.0	0.013	NR
Fe	II	234.830	23.0	10.0	0.013	NR
Fe	II	258.588	20.0	10.0	0.015	
Fe	II	238.863	20.0	10.0	0.015	
Fe	II	263.105	19.0	10.0	0.015	NR
Fe	II	263.132	19.0	10.0	0.015	NR
Fe	II	274.932	19.0	10.0	0.015	
Fe	II	275.574	16.0	10.0	0.018	
Fe	II	233.280	15.0	10.0	0.020	
Fe	II	273.955	15.0	10.0	0.020	
Ga	I	294.364	64.0	100.0	0.046	
Ga	I	417.206	45.0	100.0	0.066	
Ga	I	287.424	38.0	100.0	0.078	
Ga	I	403.298	27.0	100.0	0.111	
Ga	I	250.070	16.0	100.0	0.187	
Ga		209.050	11.0	100.0	0.272	MIT
Ga	I	245.007	10.0	100.0	0.300	
Ga	I	294.418	9.4	100.0	0.319	
Ga	I	271.965	5.7	100.0	0.526	
Ga	I	233.828	3.9	100.0	0.769	
Ga	I	265.987	3.6	100.0	0.833	
Gd	II	342.247	21.0	10.0	0.014	
Gd	II	336.223	15.0	10.0	0.020	
Gd	II	335.047	14.0	10.0	0.021	
Gd	II	335.862	14.0	10.0	0.021	
Gd	II	310.050	13.0	10.0	0.023	OH Band
Gd	II	376.839	12.0	10.0	0.025	
Gd	II	303.284	11.0	10.0	0.027	
Gd	II	343.999	10.0	10.0	0.030	
Gd	II	358.496	10.0	10.0	0.030	
Gd	II	364.619	10.0	10.0	0.030	
Gd	II	301.013	10.0	10.0	0.030	
Gd	II	354.580	9.5	10.0	0.031	
Gd	II	354.936	9.0	10.0	0.033	
Gd	II	308.199	9.0	10.0	0.033	OH Band
Gd	II	303.405	8.8	10.0	0.034	
Ge	I	209.426	75.0	100.0	0.040	
Ge	I	265.118	62.0	100.0	0.048	
Ge	I	206.866	50.0	100.0	0.060	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Ge	I	219.871	47.0	100.0	0.063	
Ge	I	265.158	36.0	100.0	0.083	
Ge	I	204.377	35.0	100.0	0.085	
Ge	I	199.824	34.0	100.0	0.088	
Ge	I	204.171	34.0	100.0	0.088	
Ge	I	259.254	29.0	100.0	0.103	
Ge	I	303.906	29.0	100.0	0.103	
Ge	I	275.459	28.0	100.0	0.107	
Ge	I	270.963	27.0	100.0	0.111	
H	I	486.133	17.0			Zaidel
H	I	434.047	5.0			Zaidel
H	I	410.174	1.5			Zaidel
H	I	397.007	0.6			Zaidel
H	I	388.905	0.3			Zaidel
H	I	383.539	0.1			Zaidel
H	I	379.790	0.1			Zaidel
Hf	II	277.336	190.0	100.0	0.015	
Hf	II	273.876	180.0	100.0	0.016	
Hf	II	264.141	160.0	100.0	0.018	
Hf	II	232.247	160.0	100.0	0.018	
Hf	II	263.871	160.0	100.0	0.018	
Hf	II	282.022	160.0	100.0	0.018	
Hf	II	251.269	150.0	100.0	0.020	NR
Hf	II	251.303	150.0	100.0	0.020	NR
Hf	II	257.167	150.0	100.0	0.020	
Hf	II	196.382	150.0	100.0	0.020	Zaidel
Hf	II	239.336	140.0	100.0	0.021	
Hf	II	239.383	140.0	100.0	0.021	
Hf	II	235.122	130.0	100.0	0.023	
Hf	II	246.419	130.0	100.0	0.023	
Hg	II	194.227	120.0	100.0	0.025	Zaidel
Hg	I	253.652	49.0	100.0	0.061	
Hg	I	296.728	1.7	100.0	1.764	
Hg	I	435.835	1.1	100.0	2.727	
Hg	I	265.204	0.7	100.0	4.285	Zaidel
Hg	I	302.150	0.6	100.0	5.000	
Hg	I	365.483	0.3	100.0	10.000	
Ho	II	345.600	53.0	10.0	0.0057	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Ho	II	339.898	23.0	10.0	0.013	
Ho	II	389.102	18.0	10.0	0.016	H 388.905
Ho	II	347.426	16.0	10.0	0.018	
Ho	II	341.646	16.0	10.0	0.018	
Ho	II	381.073	15.0	10.0	0.020	
Ho	II	348.484	15.0	10.0	0.020	
Ho	II	379.675	12.0	10.0	0.025	H 379.790
Ho	II	351.559	11.0	10.0	0.027	
Ho	II	345.314	10.0	10.0	0.030	
In	II	230.606	47.0	100.0	0.063	
In	I	325.609	25.0	100.0	0.120	
In	I	303.936	20.0	100.0	0.150	
In	I	451.131	16.0	100.0	0.187	
In	I	410.176	6.4	100.0	0.468	H 410.174
In	I	271.026	5.4	100.0	0.555	
In	I	325.856	5.0	100.0	0.600	
In	II	207.926	4.2	100.0	0.714	Zaidel
In	I	256.015	4.2	100.0	0.714	
In	I	293.263	2.0	100.0	1.500	
In	II	197.745	1.7	100.0	1.764	Zaidel
In	I	275.388	1.6	100.0	1.875	
Ir	II	224.268	110.0	100.0	0.027	
Ir	II	212.681	100.0	100.0	0.030	
Ir	I	205.222	49.0	100.0	0.061	
Ir	II	215.268	44.0	100.0	0.068	
Ir		204.419	30.0	100.0	0.100	Zaidel
Ir	I	209.263	28.0	100.0	0.107	
Ir	I	208.882	28.0	100.0	0.107	
Ir	II	236.804	24.0	100.0	0.125	
Ir	I	254.397	19.0	100.0	0.157	
Ir	I	215.805	17.0	100.0	0.176	
Ir	I	263.971	17.0	100.0	0.176	
Ir	II	216.942	13.0	100.0	0.230	
Ir	I	266.479	13.0	100.0	0.230	
Ir	I	237.277	12.0	100.0	0.250	
Ir	I	238.162	12.0	100.0	0.250	
Ir	I	250.298	12.0	100.0	0.250	
Ir	I	269.423	11.0	100.0	0.272	
Ir	I	284.972	10.0	100.0	0.300	
K	I	404.721	0.7	1000.0	42.857	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
K	I	404.414	0.0	1000.0	-----	Ar 404.442
La	II	333.749	30.0	10.0	0.010	
La	II	379.478	30.0	10.0	0.010	
La	II	408.672	30.0	10.0	0.010	
La	II	412.323	29.0	10.0	0.010	
La	II	398.852	27.0	10.0	0.011	
La	II	379.083	26.0	10.0	0.011	
La	II	399.575	22.0	10.0	0.013	
La	II	407.735	21.0	10.0	0.014	
La	II	387.164	20.0	10.0	0.015	
La	II	375.908	20.0	10.0	0.015	
La	II	404.291	19.0	10.0	0.015	
La	II	403.169	19.0	10.0	0.015	
La	II	338.091	17.0	10.0	0.017	
La	II	442.990	13.0	10.0	0.023	
La	II	384.902	12.0	10.0	0.025	
La	II	392.922	12.0	10.0	0.025	
La	II	492.098	12.0	10.0	0.025	
La	II	492.179	12.0	10.0	0.025	
La	II	394.910	NM	10.0	-----	Ar 394.898
Li	I	460.286	3.5	100.0	0.857	
Li	I	323.263	2.8	100.0	1.071	OH Band
Li	I	274.118	1.9	100.0	1.578	
Li	I	497.170	1.4	100.0	2.142	
Li	I	256.254	0.7	100.0	4.285	Zaidel
Li	I	413.262	0.4	100.0	7.500	Zaidel,NR
Li	I	413.256	0.4	100.0	7.500	Zaidel,NR
Lu	II	261.542	150.0	5.0	0.0010	
Lu	II	291.139	24.0	5.0	0.0062	
Lu	II	219.554	18.0	5.0	0.0083	
Lu	II	307.760	17.0	5.0	0.0088	OH Band
Lu	II	289.484	15.0	5.0	0.010	
Lu	II	339.707	14.0	5.0	0.010	
Lu	II	350.739	13.0	5.0	0.011	
Lu	II	270.171	12.0	5.0	0.012	
Lu	II	290.030	12.0	5.0	0.012	
Lu	II	275.417	12.0	5.0	0.012	
Lu	II	302.054	11.0	5.0	0.013	
Lu	II	347.248	10.0	5.0	0.015	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Mg	II	279.553	195.0	1.0	0.00015	
Mg	II	280.270	100.0	1.0	0.00030	
Mg	I	285.213	19.0	1.0	0.0016	
Mg	II	279.806	2.0	1.0	0.015	
Mg	I	202.582	1.3	1.0	0.023	Zaidel
Mg	II	279.079	1.0	1.0	0.030	
Mg	I	383.826	0.9	1.0	0.033	
Mg	I	383.231	0.7	1.0	0.042	
Mg	I	277.983	0.6	1.0	0.050	
Mg	II	293.654	0.5	1.0	0.060	
Mn	II	257.610	220.0	10.0	0.0014	
Mn	II	259.373	190.0	10.0	0.0016	
Mn	II	260.569	145.0	10.0	0.0021	
Mn	II	294.920	39.0	10.0	0.0077	
Mn	II	293.930	29.0	10.0	0.010	
Mn	I	279.482	24.0	10.0	0.012	
Mn	II	293.306	22.0	10.0	0.013	
Mn	I	279.827	18.0	10.0	0.016	
Mn	I	280.106	14.0	10.0	0.021	
Mn	I	403.076	6.8	10.0	0.044	
Mn	II	344.199	6.6	10.0	0.045	
Mn	I	403.307	6.3	10.0	0.047	
Mn	II	191.510	5.8	10.0	0.051	NRL
Mo	II	202.030	38.0	10.0	0.0079	
Mo	II	203.844	24.0	10.0	0.012	
Mo	II	204.598	24.0	10.0	0.012	
Mo	II	281.615	21.0	10.0	0.014	
Mo	II	201.511	16.0	10.0	0.018	
Mo	II	284.823	15.0	10.0	0.020	
Mo	II	277.540	12.0	10.0	0.025	
Mo	II	287.151	11.0	10.0	0.027	
Mo	II	268.414	10.0	10.0	0.030	
Mo	II	263.876	8.0	10.0	0.037	
Mo		292.339	8.0	10.0	0.037	
Na	I	588.995	101.0	100.0	0.029	Ar 588.859
Na	I	589.592	43.0	100.0	0.069	
Na	I	330.237	1.6	100.0	1.875	
Na	I	330.298	0.7	100.0	4.285	
Na	I	285.301	1.1	1000.0	27.272	Zaidel,NR

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Na	I	285.281	1.1	1000.0	27.272	Zaidel, NR
Na	II	288.114	0.6	1000.0	50.000	Zaidel
Nb	II	309.418	83.0	100.0	0.036	OH Band
Nb	II	316.340	75.0	100.0	0.040	OH Band
Nb	II	313.079	60.0	100.0	0.050	OH Band
Nb	II	269.706	43.0	100.0	0.069	
Nb	II	322.548	42.0	100.0	0.071	OH Band
Nb	II	319.498	41.0	100.0	0.073	OH Band
Nb	II	295.088	40.0	100.0	0.075	
Nb	II	292.781	40.0	100.0	0.075	
Nb	II	271.662	34.0	100.0	0.088	
Nb	II	288.318	31.0	100.0	0.096	
Nb	II	210.942	31.0	100.0	0.096	
Nb	II	272.198	30.0	100.0	0.100	
Nb	II	287.539	28.0	100.0	0.107	
Nd	II	401.225	59.0	100.0	0.050	
Nd	II	430.358	40.0	100.0	0.075	
Nd	II	406.109	31.0	100.0	0.096	
Nd	II	415.608	28.0	100.0	0.107	
Nd	II	410.946	26.0	100.0	0.115	
Nd	II	386.333	23.0	100.0	0.130	NR
Nd	II	386.340	23.0	100.0	0.130	NR
Nd	II	404.080	23.0	100.0	0.130	
Nd	II	417.732	22.0	100.0	0.136	
Nd	II	385.166	19.0	100.0	0.157	NR
Nd	II	385.174	19.0	100.0	0.157	NR
Nd	II	394.151	19.0	100.0	0.157	
Nd	II	445.157	19.0	100.0	0.157	
Nd	II	424.738	17.0	100.0	0.176	
Nd	II	395.116	17.0	100.0	0.176	
Nd	II	396.312	17.0	100.0	0.176	
Nd	II	384.824	16.0	100.0	0.187	NR
Nd	II	384.852	16.0	100.0	0.187	NR
Nd	II	380.536	16.0	100.0	0.187	
Ni	II	221.647	29.0	10.0	0.010	Zaidel
Ni	I	232.003	20.0	10.0	0.015	
Ni	II	231.604	19.0	10.0	0.015	
Ni	II	216.556	17.0	10.0	0.017	Zaidel
Ni	II	217.467	13.0	10.0	0.023	MIT
Ni	II	230.300	13.0	10.0	0.023	MIT

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Ni	II	227.021	12.0	10.0	0.025	Zaidel
Ni	II	225.386	12.0	10.0	0.025	Zaidel
Ni	I	234.554	9.5	10.0	0.031	
Ni	II	239.452	7.8	10.0	0.038	
Ni	I	352.454	6.6	10.0	0.045	
Ni	I	341.476	6.2	10.0	0.048	
Os	II	225.585	83.0	1.0	0.00036	
Os	II	228.226	48.0	1.0	0.00063	
Os		189.900	25.0	1.0	0.0012	APPROX. WAVE
Os	II	233.680	24.0	1.0	0.0012	
Os	II	206.721	22.0	1.0	0.0014	
Os	II	219.439	18.0	1.0	0.0017	
Os	II	236.735	16.0	1.0	0.0019	
Os	II	207.067	14.0	1.0	0.0021	
Os	II	248.624	13.0	1.0	0.0023	
Os	I	222.798	11.0	1.0	0.0027	
P	I	213.618	39.0	100.0	0.076	
P	I	214.914	39.0	100.0	0.076	
P	I	253.565	11.0	100.0	0.272	
P	I	213.547	8.5	100.0	0.352	
P	I	203.349	7.4	100.0	0.405	MIT
P	I	215.408	7.2	100.0	0.416	
P	I	255.328	5.2	100.0	0.576	
P	I	202.347	3.8	100.0	0.789	MIT
P	I	215.294	3.4	100.0	0.882	
P	I	253.401	3.0	100.0	1.000	
Pb	II	220.353	70.0	100.0	0.042	
Pb	I	216.999	33.0	100.0	0.090	
Pb	I	261.418	23.0	100.0	0.130	
Pb	I	283.306	21.0	100.0	0.142	
Pb	I	280.199	19.0	100.0	0.157	
Pb	I	405.783	11.0	100.0	0.272	
Pb	I	224.688	9.0	100.0	0.333	
Pb	I	368.348	8.6	100.0	0.348	
Pb	I	266.316	7.7	100.0	0.389	
Pb	I	239.379	6.3	100.0	0.476	
Pb	I	363.958	5.2	100.0	0.576	
Pb	I	247.638	5.1	100.0	0.588	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Pd	I	340.458	68.0	100.0	0.044	
Pd	I	363.470	55.0	100.0	0.054	
Pd	II	229.651	44.0	100.0	0.068	Zaidel
Pd	I	324.270	39.0	100.0	0.076	OH Band
Pd	I	360.955	35.0	100.0	0.085	
Pd	I	342.124	30.0	100.0	0.100	
Pd	II	248.892	29.0	100.0	0.103	
Pd	II	223.159	25.0	100.0	0.120	MIT
Pd	I	244.791	23.0	100.0	0.130	
Pd	I	351.694	22.0	100.0	0.136	
Pd	I	355.308	22.0	100.0	0.136	
Pd	I	247.642	18.0	100.0	0.166	
Pd	I	348.115	18.0	100.0	0.166	
Pd	II	244.618	18.0	100.0	0.166	Zaidel
Pd	II	235.134	17.0	100.0	0.176	Zaidel
Pd	I	346.077	16.0	100.0	0.187	
Pd		236.796	15.0	100.0	0.200	Zaidel
Pd	II	248.653	15.0	100.0	0.200	
Pr	II	390.844	8.1	10.0	0.037	
Pr	II	414.311	8.0	10.0	0.037	
Pr	II	417.939	7.2	10.0	0.041	
Pr	II	422.535	7.0	10.0	0.042	
Pr	II	422.293	6.3	10.0	0.047	
Pr	II	406.281	6.3	10.0	0.047	
Pr	II	411.846	6.0	10.0	0.050	
Pr	II	418.948	5.0	10.0	0.060	
Pr	II	440.882	4.9	10.0	0.061	
Pr	II	400.869	4.6	10.0	0.065	
Pt	II	214.423	100.0	100.0	0.030	
Pt	II	203.646	54.0	100.0	0.055	MIT
Pt	I	204.937	42.0	100.0	0.071	
Pt	I	265.945	37.0	100.0	0.081	
Pt	II	224.552	36.0	100.0	0.083	MIT
Pt	I	217.467	36.0	100.0	0.083	
Pt	I	306.471	25.0	100.0	0.120	OH Band
Pt	I	212.861	24.0	100.0	0.125	
Pt		193.700	22.0	100.0	0.136	APPROX. WAVE
Pt	I	210.333	20.0	100.0	0.150	
Pt	I	273.396	20.0	100.0	0.150	
Pt	I	248.717	20.0	100.0	0.150	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Rb	I	420.185	0.8	1000.0	37.500	
Rb	I	421.556	NM	1000.0	-----	Sr 421.552
Re	II	197.313	49.0	10.0	0.006	Zaidel
Re	II	221.426	47.0	10.0	0.006	
Re	II	227.525	44.0	10.0	0.006	
Re	II	189.836	8.0	10.0	0.037	Zaidel
Re	I	204.908	3.8	10.0	0.078	
Re	I	228.751	3.8	10.0	0.078	
Re	I	229.449	3.6	10.0	0.083	
Re	II	202.364	3.2	10.0	0.093	Zaidel
Re	II	209.241	3.2	10.0	0.093	
Re	I	346.046	2.6	10.0	0.115	
Re	I	208.559	2.4	10.0	0.125	
Rh	II	233.477	67.0	100.0	0.044	
Rh	II	249.077	52.0	100.0	0.057	
Rh	I	343.489	50.0	100.0	0.060	
Rh	II	252.053	39.0	100.0	0.076	
Rh	I	369.236	35.0	100.0	0.085	
Rh	II	246.104	28.0	100.0	0.107	
Rh	I	339.682	24.0	100.0	0.125	
Rh	II	251.103	24.0	100.0	0.125	
Rh	I	352.802	24.0	100.0	0.125	
Rh	II	242.711	24.0	100.0	0.125	
Rh	II	241.584	23.0	100.0	0.130	
Rh	I	228.857	21.0	100.0	0.142	
Rh	I	365.799	20.0	100.0	0.150	
Rh	I	350.252	20.0	100.0	0.150	
Ru	II	240.272	100.0	100.0	0.030	
Ru	II	245.657	100.0	100.0	0.030	
Ru	II	267.876	83.0	100.0	0.036	
Ru	II	269.206	33.0	100.0	0.090	
Ru	II	266.161	31.0	100.0	0.096	
Ru	II	249.842	31.0	100.0	0.096	NR
Ru	II	249.857	31.0	100.0	0.096	NR
Ru	I	349.894	27.0	100.0	0.111	
Ru	II	273.435	26.0	100.0	0.115	
Ru	II	245.644	25.0	100.0	0.120	
Ru	II	271.241	25.0	100.0	0.120	
Ru	I	372.803	25.0	100.0	0.120	
Ru	II	235.791	21.0	100.0	0.142	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Ru	II	247.893	20.0	100.0	0.150	
Ru	II	250.701	19.0	100.0	0.157	
Ru		279.535	19.0	100.0	0.157	MIT
Sb	I	206.833	91.0	100.0	0.032	
Sb	I	217.581	68.0	100.0	0.044	
Sb	I	231.147	49.0	100.0	0.061	
Sb	I	252.852	28.0	100.0	0.107	
Sb	I	259.805	28.0	100.0	0.107	NR
Sb	I	259.809	28.0	100.0	0.107	NR
Sb	I	217.919	19.0	100.0	0.157	
Sb	I	195.039	18.0	100.0	0.166	Zaidel
Sb	I	213.969	16.0	100.0	0.187	
Sb	I	204.957	15.0	100.0	0.200	
Sb	I	214.486	12.0	100.0	0.250	
Sb	I	209.841	8.7	100.0	0.344	
Sb	I	203.977	6.6	100.0	0.454	
Sb	I	220.845	6.5	100.0	0.461	
Sb	I	287.792	4.7	100.0	0.638	
Sc	II	361.384	200.0	10.0	0.0015	
Sc	II	357.253	150.0	10.0	0.0020	
Sc	II	363.075	140.0	10.0	0.0021	
Sc	II	364.279	110.0	10.0	0.0027	
Sc	II	424.683	110.0	10.0	0.0027	
Sc	II	357.635	82.0	10.0	0.0037	
Sc	II	335.373	80.0	10.0	0.0038	
Sc	II	337.215	68.0	10.0	0.0044	
Sc	II	358.094	67.0	10.0	0.0045	
Sc	II	255.237	65.0	10.0	0.0046	
Sc	II	431.409	38.0	10.0	0.0079	
Sc	II	256.025	37.0	10.0	0.0081	
Sc	II	356.770	37.0	10.0	0.0081	Ar 356.766
Sc	II	364.531	35.0	10.0	0.0086	
Sc	II	355.855	34.0	10.0	0.0088	
Sc	II	336.895	32.0	10.0	0.0094	
Sc	II	365.180	31.0	10.0	0.0097	
Sc	II	432.074	31.0	10.0	0.0097	
Sc	II	358.964	26.0	10.0	0.011	
Sc	II	353.573	24.0	10.0	0.012	
Sc	II	256.321	22.0	10.0	0.013	
Sc	II	359.048	20.0	10.0	0.015	
Sc	II	432.501	19.0	10.0	0.015	
Sc	II	336.127	17.0	10.0	0.017	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L).	EST'D DET LIM (mg/L)	COMMENTS
Sc	II	254.522	17.0	10.0	0.017	
Sc	II	437.446	17.0	10.0	0.017	
Se	I	196.026	40.0	100.0	0.075	
Se	I	203.985	26.0	100.0	0.115	
Se	I	206.279	10.0	100.0	0.300	
Se	I	207.479	1.9	100.0	1.578	
Se	I	199.511	0.6	100.0	5.000	NRL
Si	I	251.611	250.0	100.0	0.012	
Si	I	212.412	180.0	100.0	0.016	
Si	I	288.158	110.0	100.0	0.027	
Si	I	250.690	100.0	100.0	0.030	
Si	I	252.851	95.0	100.0	0.031	
Si	I	251.432	79.0	100.0	0.037	
Si	I	252.411	75.0	100.0	0.040	
Si	I	221.667	72.0	100.0	0.041	
Si	I	251.920	61.0	100.0	0.049	
Si	I	198.899	50.0	100.0	0.060	NRL
Si	I	221.089	47.0	100.0	0.063	
Si	I	243.515	36.0	100.0	0.083	
Si	I	190.134	23.0	100.0	0.130	NRL
Si	I	220.798	23.0	100.0	0.130	
Si	I	205.813	23.0	100.0	0.130	Zaidel
Sm	II	359.260	69.0	100.0	0.043	
Sm	II	442.434	55.0	100.0	0.054	
Sm	II	360.949	52.0	100.0	0.057	
Sm	II	363.429	45.0	100.0	0.066	
Sm	II	428.079	43.0	100.0	0.069	
Sm	II	446.734	41.0	100.0	0.073	
Sm	II	367.084	40.0	100.0	0.075	
Sm	II	356.827	39.0	100.0	0.076	
Sm	II	373.126	38.0	100.0	0.078	
Sm	II	443.432	36.0	100.0	0.083	
Sm	II	388.529	36.0	100.0	0.083	
Sm	II	330.639	33.0	100.0	0.090	
Sn	II	189.980	120.0	100.0	0.025	Zaidel
Sn	I	235.484	31.0	100.0	0.096	
Sn	I	242.949	31.0	100.0	0.096	
Sn	I	283.999	27.0	100.0	0.111	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Sn	I	226.891	25.0	100.0	0.120	
Sn	I	224.605	25.0	100.0	0.120	
Sn	I	242.170	19.0	100.0	0.157	
Sn	I	270.651	18.0	100.0	0.166	
Sn	I	220.965	16.0	100.0	0.187	
Sn	I	286.333	14.0	100.0	0.214	
Sn	I	317.505	14.0	100.0	0.214	OH Band
Sr	II	407.771	72.0	1.0	0.00042	
Sr	II	421.552	39.0	1.0	0.00077	
Sr	II	216.596	36.0	10.0	0.0083	
Sr	II	215.284	29.0	10.0	0.010	
Sr	II	346.446	13.0	10.0	0.023	
Sr	II	338.071	8.8	10.0	0.034	
Sr	II	430.545	4.8	10.0	0.062	
Sr	I	460.733	4.4	10.0	0.068	
Sr	II	232.235	2.9	10.0	0.103	MIT
Sr	II	416.180	2.4	10.0	0.125	
Ta	II	226.230	120.0	100.0	0.025	
Ta	II	240.063	105.0	100.0	0.028	
Ta	II	268.517	100.0	100.0	0.030	
Ta	II	233.198	96.0	100.0	0.031	
Ta	II	228.916	95.0	100.0	0.031	
Ta	II	263.558	88.0	100.0	0.034	
Ta	II	238.706	80.0	100.0	0.037	
Ta	II	223.948	69.0	100.0	0.043	
Ta	II	267.590	68.0	100.0	0.044	
Ta		205.908	68.0	100.0	0.044	MIT
Ta	II	219.603	58.0	100.0	0.051	
Ta	II	260.349	54.0	100.0	0.055	
Ta	II	248.870	54.0	100.0	0.055	
Ta	II	284.446	52.0	100.0	0.057	
Ta	II	269.452	50.0	100.0	0.060	
Ta	II	296.513	50.0	100.0	0.060	
Tb	II	350.917	130.0	100.0	0.023	
Tb	II	384.873	54.0	100.0	0.055	
Tb	II	367.635	50.0	100.0	0.060	
Tb	II	387.417	48.0	100.0	0.062	
Tb	II	356.174	47.0	100.0	0.063	
Tb	II	356.852	46.0	100.0	0.065	
Tb	II	370.286	46.0	100.0	0.065	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Tb	II	332.440	35.0	100.0	0.085	
Tb	II	389.920	31.0	100.0	0.096	
Tb	II	374.734	30.0	100.0	0.100	NR
Tb	II	374.717	30.0	100.0	0.100	NR
Tb	II	370.392	29.0	100.0	0.103	
Tb	II	329.307	29.0	100.0	0.103	
Tb	II	345.406	27.0	100.0	0.111	
Te	I	214.281	73.0	100.0	0.041	
Te	I	225.902	17.0	100.0	0.176	
Te	I	238.578	17.0	100.0	0.176	
Te	I	214.725	14.0	100.0	0.214	
Te	I	200.202	12.0	100.0	0.250	
Te	I	238.326	11.0	100.0	0.272	
Te	I	208.116	11.0	100.0	0.272	
Te	I	199.418	6.3	100.0	0.476	
Te	I	225.548	2.7	100.0	1.111	
Te	I	226.555	2.6	100.0	1.153	
Th	II	283.730	46.0	100.0	0.065	
Th	II	283.231	42.0	100.0	0.071	
Th	II	274.716	36.0	100.0	0.083	
Th	II	401.913	36.0	100.0	0.083	
Th	II	318.020	34.0	100.0	0.088	OH Band
Th	II	318.823	32.0	100.0	0.093	OH Band
Th	II	374.118	31.0	100.0	0.096	
Th	II	294.286	31.0	100.0	0.096	
Th	II	353.959	30.0	100.0	0.100	
Th	II	269.242	30.0	100.0	0.100	
Th	II	339.204	30.0	100.0	0.100	
Th	II	332.512	28.0	100.0	0.107	
Th	II	360.944	27.0	100.0	0.111	
Th	II	311.953	26.0	100.0	0.115	OH Band
Th	II	284.281	23.0	100.0	0.130	
Th	II	287.041	23.0	100.0	0.130	
Th	II	256.559	23.0	100.0	0.130	
Th	II	275.217	23.0	100.0	0.130	
Ti	II	334.941	79.0	10.0	0.0038	
Ti	II	336.121	57.0	10.0	0.0053	
Ti	II	323.452	56.0	10.0	0.0054	OH Band
Ti	II	337.280	45.0	10.0	0.0067	
Ti	II	334.904	40.0	10.0	0.0075	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Ti	II	308.802	39.0	10.0	0.0077	OH Band
Ti	II	307.864	37.0	10.0	0.0081	OH Band
Ti	II	338.376	37.0	10.0	0.0081	
Ti	II	323.657	30.0	10.0	0.010	OH Band
Ti	II	323.904	29.0	10.0	0.010	OH Band
Ti	II	368.520	26.0	10.0	0.011	
Tl	II	190.864	74.0	100.0	0.040	UCRL
Tl	I	276.787	25.0	100.0	0.120	
Tl	I	351.924	15.0	100.0	0.200	
Tl	I	377.572	13.0	100.0	0.230	
Tl	I	237.969	7.0	100.0	0.428	
Tl	I	291.832	2.9	100.0	1.034	
Tl	I	223.782	2.2	100.0	1.363	
Tl	I	352.943	1.7	100.0	1.764	
Tl	I	258.014	1.7	100.0	1.764	
Tm	II	313.126	58.0	10.0	0.0052	OH Band
Tm	II	346.220	37.0	10.0	0.0081	
Tm	II	384.802	31.0	10.0	0.0097	
Tm	II	342.508	30.0	10.0	0.010	
Tm	II	376.133	26.0	10.0	0.011	
Tm	II	379.575	26.0	10.0	0.011	
Tm	II	336.261	26.0	10.0	0.011	
Tm	II	317.283	23.0	10.0	0.013	OH Band
Tm	II	376.191	23.0	10.0	0.013	
Tm	II	313.389	22.0	10.0	0.013	OH Band
Tm	II	345.366	19.0	10.0	0.015	
Tm	II	329.100	19.0	10.0	0.015	
Tm	II	344.150	18.0	10.0	0.016	
Tm	II	324.154	16.0	10.0	0.018	OH Band
Tm	II	370.136	15.0	10.0	0.020	
Tm	II	370.026	14.0	10.0	0.021	
Tm	II	250.908	14.0	10.0	0.021	
Tm	II	286.923	14.0	10.0	0.021	
U	II	385.958	12.0	100.0	0.250	
U	II	367.007	10.0	100.0	0.300	
U	II	263.553	9.0	100.0	0.333	
U	II	409.014	8.9	100.0	0.337	
U	II	393.203	8.2	100.0	0.365	
U	II	424.167	6.5	100.0	0.461	
U	II	294.192	6.2	100.0	0.483	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
U	II	385.466	6.2	100.0	0.483	
U	II	290.828	6.0	100.0	0.500	
U	II	288.963	6.0	100.0	0.500	
U	II	288.274	5.8	100.0	0.517	
U	II	256.541	5.7	100.0	0.526	
U	II	279.394	5.6	100.0	0.535	
U	II	311.935	5.6	100.0	0.535	OH Band
U	II	330.590	5.6	100.0	0.535	
V	II	309.311	60.0	10.0	0.0050	OH Band
V	II	310.230	47.0	10.0	0.0064	OH Band
V	II	292.402	40.0	10.0	0.0075	
V	II	290.882	34.0	10.0	0.0088	
V	II	311.071	30.0	10.0	0.010	OH Band
V	II	289.332	29.0	10.0	0.010	
V	II	268.796	29.0	10.0	0.010	
V	II	311.838	25.0	10.0	0.012	OH Band
V	II	214.009	20.0	10.0	0.015	MIT
V	II	312.528	20.0	10.0	0.015	OH Band
V	II	327.612	19.0	10.0	0.015	
V	II	292.464	18.0	10.0	0.016	
V	II	270.094	17.0	10.0	0.017	
W	II	207.911	100.0	100.0	0.030	
W	II	224.875	67.0	100.0	0.044	
W		218.935	65.0	100.0	0.046	MIT
W	II	209.475	64.0	100.0	0.046	
W	II	209.860	55.0	100.0	0.054	
W	II	239.709	54.0	100.0	0.055	
W	II	222.589	50.0	100.0	0.060	Zaidel
W	II	220.448	49.0	100.0	0.061	
W	II	200.807	42.0	100.0	0.071	
W	II	208.819	41.0	100.0	0.073	
W	II	248.923	41.0	100.0	0.073	
W	II	202.998	40.0	100.0	0.075	
W	II	205.468	40.0	100.0	0.075	Zaidel
W	II	216.632	40.0	100.0	0.075	
W	II	232.609	39.0	100.0	0.076	
W	II	203.503	38.0	100.0	0.078	
Y	II	371.030	86.0	10.0	0.0035	
Y	II	324.228	67.0	10.0	0.0045	OH Band
Y	II	360.073	63.0	10.0	0.0048	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Y	II	377.433	57.0	10.0	0.0053	
Y	II	437.494	46.0	10.0	0.0065	
Y	II	378.870	40.0	10.0	0.0075	
Y	II	361.105	40.0	10.0	0.0075	
Y	II	321.669	38.0	10.0	0.0079	OH Band
Y	II	363.312	36.0	10.0	0.0083	
Y	II	224.306	33.0	10.0	0.0091	
Y	II	332.789	32.0	10.0	0.0094	
Y	II	360.192	30.0	10.0	0.010	
Y	II	417.754	26.0	10.0	0.011	
Y	II	354.901	23.0	10.0	0.013	
Y	II	320.332	20.0	10.0	0.015	OH Band
Yb	II	328.937	170.0	10.0	0.0018	
Yb	II	369.419	100.0	10.0	0.0030	
Yb	II	289.138	35.0	10.0	0.0086	
Yb	II	222.446	34.0	10.0	0.0088	
Yb	II	211.667	32.0	10.0	0.0094	
Yb	II	212.674	32.0	10.0	0.0094	
Yb	II	218.571	22.0	10.0	0.013	
Yb	II	275.048	17.0	10.0	0.017	
Yb	II	297.056	17.0	10.0	0.017	
Yb	II	265.375	14.0	10.0	0.021	
Zn	I	213.856	170.0	10.0	0.0018	
Zn	II	202.548	75.0	10.0	0.0040	
Zn	II	206.200	51.0	10.0	0.0059	
Zn	I	334.502	2.2	10.0	0.136	
Zn	I	330.259	1.3	10.0	0.230	
Zn	I	481.053	1.3	10.0	0.230	
Zn	I	472.216	0.7	10.0	0.428	
Zn	I	328.233	0.6	10.0	0.500	
Zn	I	334.557	0.4	10.0	0.750	
Zn	I	280.106	0.4	10.0	0.750	NF
Zn	I	280.087	0.4	10.0	0.750	NR
Zr	II	343.823	42.0	10.0	0.0071	
Zr	II	339.198	39.0	10.0	0.0077	
Zr	II	257.139	31.0	10.0	0.0097	
Zr	II	349.621	30.0	10.0	0.010	
Zr	II	357.247	30.0	10.0	0.010	
Zr	II	327.305	25.0	10.0	0.012	
Zr	II	256.887	22.0	10.0	0.013	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Zr	II	327.926	21.0	10.0	0.014	
Zr	II	267.863	20.0	10.0	0.015	
Zr	II	272.261	16.0	10.0	0.018	
Zr	II	273.486	14.0	10.0	0.021	
Zr	II	274.256	14.0	10.0	0.021	
Zr	II	270.013	12.0	10.0	0.025	
Zr	II	350.567	12.0	10.0	0.025	
Zr	II	355.660	12.0	10.0	0.025	
Zr	II	348.115	12.0	10.0	0.025	
Zr	II	256.764	11.0	10.0	0.027	
Zr	II	272.649	11.0	10.0	0.027	
Zr	II	330.628	11.0	10.0	0.027	
Zr	II	316.597	11.0	10.0	0.027	OH Band
Zr	II	318.286	11.0	10.0	0.027	OH Band
Zr	II	328.471	10.0	10.0	0.030	
Zr	II	274.586	10.0	10.0	0.030	
Zr	II	275.221	10.0	10.0	0.030	
Zr	II	357.685	10.0	10.0	0.030	

APPENDIX B

Prominent Lines of the Elements Emitted by the Inductively Coupled Plasma in Order of Wavelength.

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
As	I	189.042	22.0	100.0	0.136	NRL
Re	II	189.836	8.0	10.0	0.037	Zaidel
Sn	II	189.980	120.0	100.0	0.025	Zaidel
Os		189.900	25.0	1.0	0.0012	APPROX. WAVE
Si	I	190.134	23.0	100.0	0.130	NRL
Bi	II	190.241	10.0	100.0	0.300	Zaidel
Tl	II	190.864	74.0	100.0	0.040	UCRL
Mn	II	191.510	5.8	10.0	0.051	NRL
Au	I	191.893	35.0	100.0	0.085	Zaidel
C	I	193.091	67.0	100.0	0.044	NRL
As	I	193.696	56.0	100.0	0.053	
Pt		193.700	22.0	100.0	0.136	APPROX. WAVE
Hg	II	194.227	120.0	100.0	0.025	Zaidel
Sb	I	195.039	18.0	100.0	0.166	Zaidel
Au	I	195.193	18.0	100.0	0.166	Zaidel
Bi	I	195.389	14.0	100.0	0.214	
Se	I	196.026	40.0	100.0	0.075	
Hf	II	196.382	150.0	100.0	0.020	Zaidel
As	I	197.197	39.0	100.0	0.076	
Re	II	197.313	49.0	10.0	0.006	Zaidel
Au	I	197.819	77.0	100.0	0.038	Zaidel
In	II	197.745	1.7	100.0	1.764	Zaidel
Si	I	198.899	50.0	100.0	0.060	NRL
As	I	198.970	16.0	100.0	0.187	
Au	II	198.963	20.0	100.0	0.150	Zaidel
As	I	199.048	5.5	100.0	0.545	
Se	I	199.511	0.6	100.0	5.000	NRL
C	I	199.362	3.4	1000.0	8.823	NRL
Te	I	199.418	6.3	100.0	0.476	
Ge	I	199.824	34.0	100.0	0.088	
Au	II	200.081	32.0	100.0	0.093	Zaidel
Te	I	200.202	12.0	100.0	0.250	
As	I	200.334	25.0	100.0	0.120	
W	II	200.807	42.0	100.0	0.071	
As	I	200.919	6.1	100.0	0.491	
Au	I	201.200	54.0	100.0	0.055	
Mo	II	201.511	16.0	10.0	0.018	
Mo	II	202.030	38.0	10.0	0.0079	
P	I	202.347	3.8	100.0	0.789	MIT
Re	II	202.364	3.2	10.0	0.093	Zaidel
Zn	II	202.548	75.0	10.0	0.0040	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Mg	I	202.582	1.3	1.0	0.023	Zaidel
W	II	202.998	40.0	100.0	0.075	
P	I	203.349	7.4	100.0	0.405	MIT
W	II	203.503	38.0	100.0	0.078	
Pt	II	203.646	54.0	100.0	0.055	MIT
Mo	II	203.844	24.0	10.0	0.012	
Sb	I	203.977	6.6	100.0	0.454	
Se	I	203.985	26.0	100.0	0.115	
Ge	I	204.171	34.0	100.0	0.088	
Ge	I	204.377	35.0	100.0	0.085	
Ir		204.419	30.0	100.0	0.100	Zaidel
Mo	II	204.598	24.0	10.0	0.012	
Re	I	204.908	3.8	10.0	0.078	
Pt	I	204.937	42.0	100.0	0.071	
Sb	I	204.957	15.0	100.0	0.200	
Ir	I	205.222	49.0	100.0	0.061	
W	II	205.468	40.0	100.0	0.075	Zaidel
Cr	II	205.552	49.0	10.0	0.0061	
Be	I	205.590	0.7	1.0	0.042	Zaidel,NR
Be	I	205.601	0.7	1.0	0.042	Zaidel,NR
Si	I	205.813	23.0	100.0	0.130	Zaidel
Ta		205.908	68.0	100.0	0.044	MIT
Cr	II	206.149	42.0	10.0	0.0071	
Bi	I	206.170	35.0	100.0	0.085	
Zn	II	206.200	51.0	10.0	0.0059	
Se	I	206.279	10.0	100.0	0.300	
Cr	II	206.542	31.0	10.0	0.0097	
Os	II	206.721	22.0	1.0	0.0014	
Sb	I	206.833	91.0	100.0	0.032	
Ge	I	206.866	50.0	100.0	0.060	
Cs	II	207.067	14.0	1.0	0.0021	
Se	I	207.479	1.9	100.0	1.578	
W	II	207.911	100.0	100.0	0.030	
In	II	207.926	4.2	100.0	0.714	Zaidel
Au	II	208.209	70.0	100.0	0.042	Zaidel
Te	I	208.116	11.0	100.0	0.272	
Re	I	208.559	2.4	10.0	0.125	
W	II	208.819	41.0	100.0	0.073	
Ir	I	208.882	28.0	100.0	0.107	
B	I	208.893	25.0	10.0	0.012	
B	I	208.959	30.0	10.0	0.010	
Ga		209.050	11.0	100.0	0.272	MIT
Re	II	209.241	3.2	10.0	0.093	
Ir	I	209.263	28.0	100.0	0.107	
Ge	I	209.426	75.0	100.0	0.040	
W	II	209.475	64.0	100.0	0.046	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Sb	I	209.841	8.7	100.0	0.344	
W	II	209.860	55.0	100.0	0.054	
Pt	I	210.333	20.0	100.0	0.150	
Nb	II	210.942	31.0	100.0	0.096	
Bi	I	211.026	7.8	100.0	0.384	
Au	II	211.068	47.0	100.0	0.063	Zaidel
Ag	II	211.383	0.9	10.0	0.333	Zaidel
Yb	II	211.667	32.0	10.0	0.0094	
Si	I	212.412	180.0	100.0	0.016	
Yb	II	212.674	32.0	10.0	0.0094	
Ir	II	212.681	100.0	100.0	0.030	
Pt	I	212.861	24.0	100.0	0.125	
Bi	I	213.363	10.0	100.0	0.300	
P	I	213.547	8.5	100.0	0.352	
Cu	II	213.598	25.0	10.0	0.012	
P	I	213.618	39.0	100.0	0.076	
Zn	I	213.856	170.0	10.0	0.0018	
Sb	I	213.969	16.0	100.0	0.187	
V	II	214.009	20.0	10.0	0.015	MIT
Te	I	214.281	73.0	100.0	0.041	
Pt	II	214.423	100.0	100.0	0.030	
Cd	II	214.438	120.0	10.0	0.0025	
Sb	I	214.486	12.0	100.0	0.250	
Te	I	214.725	14.0	100.0	0.214	
P	I	214.914	39.0	100.0	0.076	
Ir	II	215.268	44.0	100.0	0.068	
Sr	II	215.284	29.0	10.0	0.010	
P	I	215.294	3.4	100.0	0.882	
P	I	215.408	7.2	100.0	0.416	
Ir	I	215.805	17.0	100.0	0.176	
Ni	II	216.556	17.0	10.0	0.017	Zaidel
Sr	II	216.596	36.0	10.0	0.0083	
W	II	216.632	40.0	100.0	0.075	
Ir	II	216.942	13.0	100.0	0.230	
Pb	I	216.999	33.0	100.0	0.090	
Ni	II	217.467	13.0	10.0	0.023	MIT
Pt	I	217.467	36.0	100.0	0.083	
Be	I	217.499	2.5	1.0	0.012	NR
Be	I	217.510	2.5	1.0	0.012	NR
Sb	I	217.581	68.0	100.0	0.044	
Cu	I	217.894	17.0	10.0	0.017	
Sb	I	217.919	19.0	100.0	0.157	
Yb	II	218.571	22.0	10.0	0.013	
W		218.935	65.0	100.0	0.046	MIT
Cu	II	219.226	17.0	10.0	0.017	
Cs	II	219.439	18.0	1.0	0.0017	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Iu	II	219.554	18.0	5.0	0.0083	
Ta	II	219.603	58.0	100.0	0.051	
Ge	I	219.871	47.0	100.0	0.063	
Cu	I	219.958	31.0	10.0	0.0097	
Pb	II	220.353	70.0	100.0	0.042	
W	II	220.448	49.0	100.0	0.061	
Si	I	220.798	23.0	100.0	0.130	
Sb	I	220.845	6.5	100.0	0.461	
Sn	I	220.965	16.0	100.0	0.187	
Al	I	221.006	4.8	10.0	0.062	Zaidel
Si	I	221.089	47.0	100.0	0.063	
Re	II	221.426	47.0	10.0	0.006	
Cu	I	221.458	13.0	10.0	0.023	
Ni	II	221.647	29.0	10.0	0.010	Zaidel
Si	I	221.667	72.0	100.0	0.041	
Cu	II	221.810	17.0	10.0	0.017	Zaidel
Yb	II	222.446	34.0	10.0	0.0088	
W	II	222.589	50.0	100.0	0.060	Zaidel
Cu	I	222.778	19.0	10.0	0.015	
Cs	I	222.798	11.0	1.0	0.0027	
Bi	I	222.825	36.0	100.0	0.083	
Cu	I	223.008	23.0	10.0	0.013	
Bi	I	223.061	87.0	100.0	0.034	
Pd	II	223.159	25.0	100.0	0.120	MIT
Tl	I	223.782	2.2	100.0	1.363	
Ta	II	223.948	69.0	100.0	0.043	
Ir	II	224.268	110.0	100.0	0.027	
Y	II	224.306	33.0	10.0	0.0091	
Pt	II	224.552	36.0	100.0	0.083	MIT
Sn	I	224.605	25.0	100.0	0.120	
Ag	II	224.641	2.3	10.0	0.130	Zaidel
Pb	I	224.688	9.0	100.0	0.333	
Cu	II	224.700	39.0	10.0	0.0077	
Ag	II	224.874	0.6	10.0	0.500	Zaidel
W	II	224.875	67.0	100.0	0.044	
Ni	II	225.386	12.0	10.0	0.025	Zaidel
Ba	II	225.473	2.0	10.0	0.150	Zaidel
Te	I	225.548	2.7	100.0	1.111	
Os	II	225.585	83.0	1.0	0.00036	
Te	I	225.902	17.0	100.0	0.176	
Ta	II	226.230	120.0	100.0	0.025	
Al	I	226.346	5.0	10.0	0.060	Zaidel
Cd	II	226.502	89.0	10.0	0.0034	
Te	I	226.555	2.6	100.0	1.153	
Sn	I	226.891	25.0	100.0	0.120	
Al	I	226.910	9.0	10.0	0.033	NR

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Al	I	226.922	9.0	10.0	0.033	NR
Ni	II	227.021	12.0	10.0	0.025	Zaidel
Re	II	227.525	44.0	10.0	0.006	
Bi	I	227.658	12.0	100.0	0.250	
Os	II	228.226	48.0	1.0	0.00063	
Co	II	228.616	43.0	10.0	0.0070	
Re	I	228.751	3.8	10.0	0.078	
Cd	I	228.802	110.0	10.0	0.0027	
As	I	228.812	36.0	100.0	0.083	
Rh	I	228.857	21.0	100.0	0.142	
Ta	II	228.916	95.0	100.0	0.031	
Re	I	229.449	3.6	10.0	0.083	
Pd	II	229.651	44.0	100.0	0.068	Zaidel
Ni	II	230.300	13.0	10.0	0.023	MIT
Ba	II	230.424	73.0	10.0	0.0041	
In	II	230.606	47.0	100.0	0.063	
Co	II	230.786	31.0	10.0	0.0097	
Sb	I	231.147	49.0	100.0	0.061	
Co	II	231.160	23.0	10.0	0.013	
Cd	I	231.284	0.5	10.0	0.600	
Co	II	231.405	18.0	10.0	0.016	
Co	II	231.498	13.0	10.0	0.023	
Ni	II	231.604	19.0	10.0	0.015	
Ni	I	232.003	20.0	10.0	0.015	
Sr	II	232.235	2.9	10.0	0.103	MIT
Hf	II	232.247	160.0	100.0	0.018	
Ag	II	232.505	0.7	10.0	0.428	Zaidel
W	II	232.609	39.0	100.0	0.076	
Ag	II	233.137	0.5	10.0	0.600	
Ta	II	233.198	96.0	100.0	0.031	
Fe	II	233.280	15.0	10.0	0.020	
Rh	II	233.477	67.0	100.0	0.044	
Ba	II	233.527	75.0	10.0	0.0040	
Os	II	233.680	24.0	1.0	0.0012	
Ga	I	233.828	3.9	100.0	0.769	
Fe	II	234.349	29.0	10.0	0.010	
Co	II	234.426	14.0	10.0	0.021	
Ni	I	234.554	9.5	10.0	0.031	
Co	II	234.739	13.0	10.0	0.023	
Ba	II	234.758	7.8	10.0	0.038	
Fe	II	234.810	23.0	10.0	0.013	NR
Fe	II	234.830	23.0	10.0	0.013	NR
Be	I	234.861	96.0	1.0	0.00031	
As	I	234.984	21.0	100.0	0.142	
Hf	II	235.122	130.0	100.0	0.023	
Pd	II	235.134	17.0	100.0	0.176	Zaidel

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Co	II	235.342	17.0	10.0	0.017	
Sn	I	235.484	31.0	100.0	0.096	
Fu	II	235.791	21.0	100.0	0.142	
Co	II	236.379	27.0	10.0	0.011	
Al	I	236.705	5.8	10.0	0.051	
Cs	II	236.735	16.0	1.0	0.0019	
Pd		236.796	15.0	100.0	0.200	Zaidel
Ir	II	236.804	24.0	100.0	0.125	
Ir	I	237.277	12.0	100.0	0.250	
Al	I	237.312	10.0	10.0	0.030	NR
Al	I	237.335	10.0	10.0	0.030	NR
Co	II	237.862	31.0	10.0	0.0097	
Tl	I	237.969	7.0	100.0	0.428	
Ir	I	238.162	12.0	100.0	0.250	
Fe	II	238.204	65.0	10.0	0.0046	
Te	I	238.326	11.0	100.0	0.272	
Co	II	238.346	21.0	10.0	0.014	
Te	I	238.578	17.0	100.0	0.176	
Co	II	238.636	14.0	10.0	0.021	
Ta	II	238.706	80.0	100.0	0.037	
Dy	II	238.736	5.8	10.0	0.051	
Fe	II	238.863	20.0	10.0	0.015	
Co	II	238.892	50.0	10.0	0.0060	
Hf	II	239.336	140.0	100.0	0.021	
Pb	I	239.379	6.3	100.0	0.476	
Hf	II	239.383	140.0	100.0	0.021	
Ni	II	239.452	7.8	10.0	0.038	
Fe	II	239.562	59.0	10.0	0.0051	
W	II	239.709	54.0	100.0	0.055	
Ta	II	240.063	105.0	100.0	0.028	
Ru	II	240.272	100.0	100.0	0.030	
Fe	II	240.488	27.0	10.0	0.011	
Ag	II	241.318	1.5	10.0	0.200	
Rh	II	241.584	23.0	100.0	0.130	
Sn	I	242.170	19.0	100.0	0.157	
Rh	II	242.711	24.0	100.0	0.125	
Au	I	242.795	170.0	100.0	0.017	
Sn	I	242.949	31.0	100.0	0.096	
Si	I	243.515	36.0	100.0	0.083	
Ag	II	243.779	2.5	10.0	0.120	
Pd	II	244.618	18.0	100.0	0.166	Zaidel
Pd	I	244.791	23.0	100.0	0.130	
Ga	I	245.007	10.0	100.0	0.300	
Ru	II	245.644	25.0	100.0	0.120	
Ru	II	245.657	100.0	100.0	0.030	
Rh	II	246.104	28.0	100.0	0.107	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Hf	II	246.419	130.0	100.0	0.023	
Pb	I	247.638	5.1	100.0	0.588	
Pd	I	247.642	18.0	100.0	0.166	
C	I	247.856	17.0	100.0	0.176	
Ru	II	247.893	20.0	100.0	0.150	
Os	II	248.624	13.0	1.0	0.0023	
Pd	II	248.653	15.0	100.0	0.200	
Pt	I	248.717	20.0	100.0	0.150	
Ta	II	248.870	54.0	100.0	0.055	
Pd	II	248.892	29.0	100.0	0.103	
W	II	248.923	41.0	100.0	0.073	
Rh	II	249.077	52.0	100.0	0.057	
Be	I	249.473	8.0	1.0	0.0038	Group NR
B	I	249.678	53.0	10.0	0.0057	
B	I	249.773	63.0	10.0	0.0048	
Ru	II	249.842	31.0	100.0	0.096	NR
Ru	II	249.857	31.0	100.0	0.096	NR
Ga	I	250.070	16.0	100.0	0.187	
Ir	I	250.298	12.0	100.0	0.250	
Si	I	250.690	100.0	100.0	0.030	
Ru	II	250.701	19.0	100.0	0.157	
Tm	II	250.908	14.0	10.0	0.021	
Rh	II	251.103	24.0	100.0	0.125	
Hf	II	251.269	150.0	100.0	0.020	NR
Hf	II	251.303	150.0	100.0	0.020	NR
Si	I	251.432	79.0	100.0	0.037	
Si	I	251.611	250.0	100.0	0.012	
Si	I	251.920	61.0	100.0	0.049	
Rh	II	252.053	39.0	100.0	0.076	
Si	I	252.411	75.0	100.0	0.040	
Si	I	252.851	95.0	100.0	0.031	
Sb	I	252.852	28.0	100.0	0.107	
P	I	253.401	3.0	100.0	1.000	
P	I	253.565	11.0	100.0	0.272	
Hg	I	253.652	49.0	100.0	0.061	
Ir	I	254.397	19.0	100.0	0.157	
Sc	II	254.522	17.0	10.0	0.017	
Sc	II	255.237	65.0	10.0	0.0046	
P	I	255.328	5.2	100.0	0.576	
In	I	256.015	4.2	100.0	0.714	
Sc	II	256.025	37.0	10.0	0.0081	
Li	I	256.254	0.7	100.0	4.285	Zaidel
Sc	II	256.321	22.0	10.0	0.013	
U	II	256.541	5.7	100.0	0.526	
Th	II	256.559	23.0	100.0	0.130	
Zr	II	256.764	11.0	10.0	0.027	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Zr	II	256.887	22.0	10.0	0.013	
Zr	II	257.139	31.0	10.0	0.0097	
Hf	II	257.167	150.0	100.0	0.020	
Al	I	257.510	4.0	10.0	0.075	
Mn	II	257.610	220.0	10.0	0.0014	
Tl	I	258.014	1.7	100.0	1.764	
Fe	II	258.588	20.0	10.0	0.015	
Ge	I	259.254	29.0	100.0	0.103	
Mn	II	259.373	190.0	10.0	0.0016	
Sb	I	259.805	28.0	100.0	0.107	NR
Sb	I	259.809	28.0	100.0	0.107	NR
Fe	II	259.837	24.0	10.0	0.012	
Fe	II	259.940	48.0	10.0	0.0062	
Ta	II	260.349	54.0	100.0	0.055	
Mn	II	260.569	145.0	10.0	0.0021	
Fe	II	261.187	24.0	10.0	0.012	
Pb	I	261.418	23.0	100.0	0.130	
Lu	II	261.542	150.0	5.0	0.0010	
Fe	II	263.105	19.0	10.0	0.015	NR
Fe	II	263.132	19.0	10.0	0.015	NR
U	II	263.553	9.0	100.0	0.333	
Ta	II	263.558	88.0	100.0	0.034	
Hf	II	263.871	160.0	100.0	0.018	
Mo	II	263.876	8.0	10.0	0.037	
Ir	I	263.971	17.0	100.0	0.176	
Hf	II	264.141	160.0	100.0	0.018	
Be	I	265.045	6.4	1.0	0.0047	Group NR
Ge	I	265.118	62.0	100.0	0.048	
Ge	I	265.158	36.0	100.0	0.083	
Hg	I	265.204	0.7	100.0	4.285	Zaidel
Yb	II	265.375	14.0	10.0	0.021	
Pt	I	265.945	37.0	100.0	0.081	
Ga	I	265.987	3.6	100.0	0.833	
Ru	II	266.161	31.0	100.0	0.096	
Pb	I	266.316	7.7	100.0	0.389	
Ir	I	266.479	13.0	100.0	0.230	
Cr	II	266.602	14.0	10.0	0.021	
Ta	II	267.590	68.0	100.0	0.044	
Au	I	267.595	96.0	100.0	0.031	
Cr	II	267.716	42.0	10.0	0.0071	
Zr	II	267.863	20.0	10.0	0.015	
Ru	II	267.876	83.0	100.0	0.036	
Mo	II	268.414	10.0	10.0	0.030	
Ta	II	268.517	100.0	100.0	0.030	
V	II	268.796	29.0	10.0	0.010	
Ru	II	269.206	33.0	100.0	0.090	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Th	II	269.242	30.0	100.0	0.100	
Ir	I	269.423	11.0	100.0	0.272	
Ta	II	269.452	50.0	100.0	0.060	
Nb	II	269.706	43.0	100.0	0.069	
Zr	II	270.013	12.0	10.0	0.025	
V	II	270.094	17.0	10.0	0.017	
Lu	II	270.171	12.0	5.0	0.012	
Sn	I	270.651	18.0	100.0	0.166	
Ge	I	270.963	27.0	100.0	0.111	
In	I	271.026	5.4	100.0	0.555	
Ru	II	271.241	25.0	100.0	0.120	
Nb	II	271.662	34.0	100.0	0.088	
Ga	I	271.965	5.7	100.0	0.526	
Nb	II	272.198	30.0	100.0	0.100	
Zr	II	272.261	16.0	10.0	0.018	
Zr	II	272.649	11.0	10.0	0.027	
Eu	II	272.778	37.0	10.0	0.0081	
Pt	I	273.396	20.0	100.0	0.150	
Ru	II	273.435	26.0	100.0	0.115	
Zr	II	273.486	14.0	10.0	0.021	
Hf	II	273.876	180.0	100.0	0.016	
Fe	II	273.955	15.0	10.0	0.020	
Li	I	274.118	1.9	100.0	1.578	
Zr	II	274.256	14.0	10.0	0.021	
Zr	II	274.586	10.0	10.0	0.030	
Th	II	274.716	36.0	100.0	0.083	
Fe	II	274.932	19.0	10.0	0.015	
Yb	II	275.048	17.0	10.0	0.017	
Th	II	275.217	23.0	100.0	0.130	
Zr	II	275.221	10.0	10.0	0.030	
In	I	275.388	1.6	100.0	1.875	
Lu	II	275.417	12.0	5.0	0.012	
Ge	I	275.459	28.0	100.0	0.107	
Fe	II	275.574	16.0	10.0	0.018	
Cr	II	276.259	15.0	10.0	0.020	
Cr	II	276.654	22.0	10.0	0.013	
Tl	I	276.787	25.0	100.0	0.120	
Hf	II	277.336	190.0	100.0	0.015	
Mo	II	277.540	12.0	10.0	0.025	
Mg	I	277.983	0.6	1.0	0.050	
As	I	278.022	5.7	100.0	0.526	
Mg	II	279.079	1.0	1.0	0.030	
U	II	279.394	5.6	100.0	0.535	
Mn	I	279.482	24.0	10.0	0.012	
Ru		279.535	19.0	100.0	0.157	MIT
Mg	II	279.553	195.0	1.0	0.00015	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Mg	II	279.806	2.0	1.0	0.015	
Mn	I	279.827	18.0	10.0	0.016	
Zn	I	280.087	0.4	10.0	0.750	NR
Mn	I	280.106	14.0	10.0	0.021	
Zn	I	280.106	0.4	10.0	0.750	NR
Pb	I	280.199	19.0	100.0	0.157	
Mg	II	280.270	100.0	1.0	0.00030	
Eu	II	281.394	22.0	10.0	0.013	
Mo	II	281.615	21.0	10.0	0.014	
Hf	II	282.022	160.0	100.0	0.018	
Th	II	283.231	42.0	100.0	0.071	
Pb	I	283.306	21.0	100.0	0.142	
Cr	II	283.563	42.0	10.0	0.0071	
Th	II	283.730	46.0	100.0	0.065	
Sn	I	283.999	27.0	100.0	0.111	
Th	II	284.281	23.0	100.0	0.130	
Cr	II	284.325	35.0	10.0	0.0086	
Ta	II	284.446	52.0	100.0	0.057	
Mo	II	284.823	15.0	10.0	0.020	
Ir	I	284.972	10.0	100.0	0.300	
Cr	II	284.984	21.0	10.0	0.014	
Mg	I	285.213	19.0	1.0	0.0016	
Na	I	285.281	1.1	1000.0	27.272	Zaidel, NR
Na	I	285.301	1.1	1000.0	27.272	Zaidel, NR
Cr	II	285.568	16.0	10.0	0.018	
Cr	II	286.257	15.0	10.0	0.020	
Sn	I	286.333	14.0	100.0	0.214	
Cr	II	286.511	14.0	10.0	0.021	
Cr	II	286.674	13.0	10.0	0.023	
Tm	II	286.923	14.0	10.0	0.021	
Th	II	287.041	23.0	100.0	0.130	
Mo	II	287.151	11.0	10.0	0.027	
Ga	I	287.424	38.0	100.0	0.078	
Nb	II	287.539	28.0	100.0	0.107	
Sb	I	287.792	4.7	100.0	0.638	
Na	II	288.114	0.6	1000.0	50.000	Zaidel
Si	I	288.158	110.0	100.0	0.027	
U	II	288.274	5.8	100.0	0.517	
Nb	II	288.318	31.0	100.0	0.096	
U	II	288.963	6.0	100.0	0.500	
Yb	II	289.138	35.0	10.0	0.0086	
V	II	289.332	29.0	10.0	0.010	
Lu	II	289.484	15.0	5.0	0.010	
Bi	I	289.798	9.0	100.0	0.333	
Lu	II	290.030	12.0	5.0	0.012	
U	II	290.828	6.0	100.0	0.500	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
V	II	290.882	34.0	10.0	0.0088	
Er	II	291.036	11.0	10.0	0.027	
Lu	II	291.139	24.0	5.0	0.0062	
Tl	I	291.832	2.9	100.0	1.034	
Mo		292.339	8.0	10.0	0.037	
V	II	292.402	40.0	10.0	0.0075	
V	II	292.464	18.0	10.0	0.016	
Nb	II	292.781	40.0	100.0	0.075	
In	I	293.263	2.0	100.0	1.500	
Mn	II	293.306	22.0	10.0	0.013	
Mg	II	293.654	0.5	1.0	0.060	
Mn	II	293.930	29.0	10.0	0.010	
U	II	294.192	6.2	100.0	0.483	
Th	II	294.286	31.0	100.0	0.096	
Ga	I	294.364	64.0	100.0	0.046	
Ga	I	294.418	9.4	100.0	0.319	
Mn	II	294.920	39.0	10.0	0.0077	
Nb	II	295.088	40.0	100.0	0.075	
Er	II	296.452	11.0	10.0	0.027	
Ta	II	296.513	50.0	100.0	0.060	
Hg	I	296.728	1.7	100.0	1.764	
Yb	II	297.056	17.0	10.0	0.017	
Gd	II	301.013	10.0	10.0	0.030	
Lu	II	302.054	11.0	5.0	0.013	
Hg	I	302.150	0.6	100.0	5.000	
Gd	II	303.284	11.0	10.0	0.027	
Gd	II	303.405	8.8	10.0	0.034	
Ge	I	303.906	29.0	100.0	0.103	
In	I	303.936	20.0	100.0	0.150	
Pt	I	306.471	25.0	100.0	0.120	OH Band
Bi	I	306.772	40.0	100.0	0.075	OH Band
Lu	II	307.760	17.0	5.0	0.0088	OH Band
Ti	II	307.864	37.0	10.0	0.0081	OH Band
Gd	II	308.199	9.0	10.0	0.033	OH Band
Al	I	308.215	6.6	10.0	0.045	OH Band
Ti	II	308.802	39.0	10.0	0.0077	OH Band
Al	I	309.271	13.0	10.0	0.023	OH Band
Al	I	309.284	13.0	10.0	0.023	OH Band
V	II	309.311	60.0	10.0	0.0050	OH Band
Nb	II	309.418	83.0	100.0	0.036	OH Band
Gd	II	310.050	13.0	10.0	0.023	OH Band
V	II	310.230	47.0	10.0	0.0064	OH Band
V	II	311.071	30.0	10.0	0.010	OH Band
V	II	311.838	25.0	10.0	0.012	OH Band
U	II	311.935	5.6	100.0	0.535	OH Band
Th	II	311.953	26.0	100.0	0.115	OH Band

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
V	II	312.528	20.0	10.0	0.015	OH Band
Be	II	313.042	110.0	1.0	0.00027	OH Band
Nb	II	313.079	60.0	100.0	0.050	OH Band
Be	II	313.107	41.0	1.0	0.00073	OH Band
Tm	II	313.126	58.0	10.0	0.0052	OH Band
Tm	II	313.389	22.0	10.0	0.013	OH Band
Nb	II	316.340	75.0	100.0	0.040	OH Band
Zr	II	316.597	11.0	10.0	0.027	OH Band
Tm	II	317.283	23.0	10.0	0.013	OH Band
Ar	I	317.296	1.4			OH Band,Zaidel
Sn	I	317.505	14.0	100.0	0.214	OH Band
Ca	II	317.933	1.5	0.5	0.010	OH Band
Th	II	318.020	34.0	100.0	0.088	OH Band
Zr	II	318.286	11.0	10.0	0.027	OH Band
Th	II	318.823	32.0	100.0	0.093	OH Band
Nb	II	319.498	41.0	100.0	0.073	OH Band
Ar	I	320.039	0.8			OH Band,Zaidel
Y	II	320.332	20.0	10.0	0.015	OH Band
Y	II	321.669	38.0	10.0	0.0079	OH Band
Nb	II	322.548	42.0	100.0	0.071	OH Band
Er	II	323.058	16.0	10.0	0.018	OH Band
Li	I	323.263	2.8	100.0	1.071	OH Band
Ar	I	323.449	0.8			OH Band,Zaidel
Ti	II	323.452	56.0	10.0	0.0054	OH Band
Ti	II	323.657	30.0	10.0	0.010	OH Band
Ti	II	323.904	29.0	10.0	0.010	OH Band
Tm	II	324.154	16.0	10.0	0.018	OH Band
Y	II	324.228	67.0	10.0	0.0045	OH Band
Pd	I	324.270	39.0	100.0	0.076	OH Band
Cu	I	324.754	56.0	10.0	0.0054	OH Band
In	I	325.609	25.0	100.0	0.120	
Ar	I	325.758	0.7			Zaidel
In	I	325.856	5.0	100.0	0.600	
Cd	I	326.106	0.9	10.0	0.333	
Er	II	326.478	16.0	10.0	0.018	
Zr	II	327.305	25.0	10.0	0.012	
Cu	I	327.396	31.0	10.0	0.0097	
V	II	327.612	19.0	10.0	0.015	
Zr	II	327.926	21.0	10.0	0.014	
Ag	I	328.068	38.0	10.0	0.007	
Zn	I	328.233	0.6	10.0	0.500	
Zr	II	328.471	10.0	10.0	0.030	
Yb	II	328.937	170.0	10.0	0.0018	
Tm	II	329.100	19.0	10.0	0.015	
Tb	II	329.307	29.0	100.0	0.103	
Na	I	330.237	1.6	100.0	1.875	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Zn	I	330.259	1.3	10.0	0.230	
Na	I	330.298	0.7	100.0	4.285	
U	II	330.590	5.6	100.0	0.535	
Zr	II	330.628	11.0	10.0	0.027	
Sm	II	330.639	33.0	100.0	0.090	
Er	II	331.242	10.0	10.0	0.030	
Ar	I	331.935	3.1			Zaidel
Be	I	332.134	1.4	1.0	0.021	Group NR
Tb	II	332.440	35.0	100.0	0.085	
Th	II	332.512	28.0	100.0	0.107	
Ar	I	332.550	1.1			Zaidel
Y	II	332.789	32.0	10.0	0.0094	
La	II	333.749	30.0	10.0	0.010	
Zn	I	334.502	2.2	10.0	0.136	
Zn	I	334.557	0.4	10.0	0.750	
Ti	II	334.904	40.0	10.0	0.0075	
Ti	II	334.941	79.0	10.0	0.0038	
Gd	II	335.047	14.0	10.0	0.021	
Sc	II	335.373	80.0	10.0	0.0038	
Gd	II	335.862	14.0	10.0	0.021	
Ti	II	336.121	57.0	10.0	0.0053	
Sc	II	336.127	17.0	10.0	0.017	
Gd	II	336.223	15.0	10.0	0.020	
Tm	II	336.261	26.0	10.0	0.011	
Sc	II	336.895	32.0	10.0	0.0094	
Sc	II	337.215	68.0	10.0	0.0044	
Er	II	337.271	29.0	10.0	0.010	
Ti	II	337.280	45.0	10.0	0.0067	
Ar	I	337.348	1.8			Zaidel
Sr	II	338.071	8.8	10.0	0.034	
La	II	338.091	17.0	10.0	0.017	
Ag	I	338.289	23.0	10.0	0.013	
Ti	II	338.376	37.0	10.0	0.0081	
Dy	II	338.502	9.0	10.0	0.033	
Er	II	338.508	8.8	10.0	0.034	
Zr	II	339.198	39.0	10.0	0.0077	
Er	II	339.200	9.4	10.0	0.031	
Th	II	339.204	30.0	100.0	0.100	
Ar	I	339.278	1.8			Zaidel
Ar	I	339.375	3.6			Zaidel
Rh	I	339.682	24.0	100.0	0.125	
Lu	II	339.707	14.0	5.0	0.010	
Ho	II	339.898	23.0	10.0	0.013	
Pd	I	340.458	68.0	100.0	0.044	
Ar	I	340.618	1.6			Zaidel
Dy	II	340.780	11.0	10.0	0.027	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Ni	I	341.476	6.2	10.0	0.048	
Ho	II	341.646	16.0	10.0	0.018	
Pd	I	342.124	30.0	100.0	0.100	
Gd	II	342.247	21.0	10.0	0.014	
Tm	II	342.508	30.0	10.0	0.010	
Rh	I	343.489	50.0	100.0	0.060	
Zr	II	343.823	42.0	10.0	0.0071	
Gd	II	343.999	10.0	10.0	0.030	
Tm	II	344.150	18.0	10.0	0.016	
Mn	II	344.199	6.6	10.0	0.045	
Ho	II	345.314	10.0	10.0	0.030	
Tm	II	345.366	19.0	10.0	0.015	
Tb	II	345.406	27.0	100.0	0.111	
Ho	II	345.600	53.0	10.0	0.0057	
Re	I	346.046	2.6	10.0	0.115	
Pd	I	346.077	16.0	100.0	0.187	
Ar	I	346.108	3.5			Zaidel
Tm	II	346.220	37.0	10.0	0.0081	
Sr	II	346.446	13.0	10.0	0.023	
Cd	I	346.620	0.7	10.0	0.428	
Lu	II	347.248	10.0	5.0	0.015	
Ho	II	347.426	16.0	10.0	0.018	
Zr	II	348.115	12.0	10.0	0.025	
Pd	I	348.115	18.0	100.0	0.166	
Ho	II	348.484	15.0	10.0	0.020	
Ar	I	349.327	0.9			Zaidel
Zr	II	349.621	30.0	10.0	0.010	
Ru	I	349.894	27.0	100.0	0.111	
Er	II	349.910	17.0	10.0	0.017	
Rh	I	350.252	20.0	100.0	0.150	
Zr	II	350.567	12.0	10.0	0.025	
Ar	I	350.649	2.0			Zaidel
Lu	II	350.739	13.0	5.0	0.011	
Tb	II	350.917	130.0	100.0	0.023	
Ho	II	351.559	11.0	10.0	0.027	
Pd	I	351.694	22.0	100.0	0.136	
Tl	I	351.924	15.0	100.0	0.200	
Dy	II	352.398	7.4	10.0	0.040	
Ni	I	352.454	6.6	10.0	0.045	
Rh	I	352.802	24.0	100.0	0.125	
Tl	I	352.943	1.7	100.0	1.764	
Dy	II	353.170	30.0	10.0	0.010	
Sc	II	353.573	24.0	10.0	0.012	
Dy	II	353.602	10.0	10.0	0.030	
Dy	II	353.862	6.6	10.0	0.045	
Th	II	353.959	30.0	100.0	0.100	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Gd	II	354.580	9.5	10.0	0.031	
Y	II	354.901	23.0	10.0	0.013	
Gd	II	354.936	9.0	10.0	0.033	
Pd	I	355.308	22.0	100.0	0.136	
Ar	I	355.431	18.0			Zaidel
Ar	I	355.601	1.7			Zaidel
Zr	II	355.660	12.0	10.0	0.025	
Sc	II	355.855	34.0	10.0	0.0088	
Tb	II	356.174	47.0	100.0	0.063	
Ar	I	356.329	3.2			Zaidel
Ar	I	356.434	2.1			Zaidel
Ar	I	356.766	8.6			Zaidel
Sc	II	356.770	37.0	10.0	0.0081	Ar 356.766
Sm	II	356.827	39.0	100.0	0.076	
Tb	II	356.852	46.0	100.0	0.065	
Ar	I	357.229	2.3			Zaidel
Zr	II	357.247	30.0	10.0	0.010	
Sc	II	357.253	150.0	10.0	0.0020	
Dy	II	357.624	6.4	10.0	0.046	
Sc	II	357.635	82.0	10.0	0.0037	
Zr	II	357.685	10.0	10.0	0.030	
Cr	II	357.869	13.0	10.0	0.023	
Sc	II	358.094	67.0	10.0	0.0045	
Gd	II	358.496	10.0	10.0	0.030	
Sc	II	358.964	26.0	10.0	0.011	
Sc	II	359.048	20.0	10.0	0.015	
Sm	II	359.260	69.0	100.0	0.043	
Y	II	360.073	63.0	10.0	0.0048	
Y	II	360.192	30.0	10.0	0.010	
Ar	I	360.652	8.7			Zaidel
Th	II	360.944	27.0	100.0	0.111	
Sm	II	360.949	52.0	100.0	0.057	
Pd	I	360.955	35.0	100.0	0.085	
Cd	I	361.051	1.3	10.0	0.230	
Y	II	361.105	40.0	10.0	0.0075	
Sc	II	361.384	200.0	10.0	0.0015	
Sc	II	363.075	140.0	10.0	0.0021	
Ar	I	363.268	3.5			Zaidel
Y	II	363.312	36.0	10.0	0.0083	
Sm	II	363.429	45.0	100.0	0.066	
Ar	I	363.446	3.9			Zaidel
Pd	I	363.470	55.0	100.0	0.054	
Pb	I	363.958	5.2	100.0	0.576	
Sc	II	364.279	110.0	10.0	0.0027	
Ar	I	364.312	1.5			Zaidel
Sc	II	364.531	35.0	10.0	0.0086	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Dy	II	364.540	13.0	10.0	0.023	
Gd	II	364.619	10.0	10.0	0.030	
Ar	I	364.983	7.0			Zaidel
Sc	II	365.180	31.0	10.0	0.0097	
Hg	I	365.483	0.3	100.0	10.000	
Rh	I	365.799	20.0	100.0	0.150	
Ar	I	365.953	1.4			Zaidel
U	II	367.007	10.0	100.0	0.300	
Ar	I	367.067	2.4			Zaidel
Sm	II	367.084	40.0	100.0	0.075	
Ar	I	367.524	1.1			Zaidel
Tb	II	367.635	50.0	100.0	0.060	
Pb	I	368.348	8.6	100.0	0.348	
Ti	II	368.520	26.0	10.0	0.011	
Ar	I	369.090	2.0			Zaidel
Rh	I	369.236	35.0	100.0	0.085	
Er	II	369.265	16.0	10.0	0.018	
Yb	II	369.419	100.0	10.0	0.0030	
Tm	II	370.026	14.0	10.0	0.021	
Tm	II	370.136	15.0	10.0	0.020	
Tb	II	370.286	46.0	100.0	0.065	
Tb	II	370.392	29.0	100.0	0.103	
Y	II	371.030	86.0	10.0	0.0035	
Eu	II	372.494	34.0	10.0	0.0088	
Ru	I	372.803	25.0	100.0	0.120	
Sm	II	373.126	38.0	100.0	0.078	
Th	II	374.118	31.0	100.0	0.096	
Tb	II	374.717	30.0	100.0	0.100	NR
Tb	II	374.734	30.0	100.0	0.100	NR
La	II	375.908	20.0	10.0	0.015	
Tm	II	376.133	26.0	10.0	0.011	
Tm	II	376.191	23.0	10.0	0.013	
Gd	II	376.839	12.0	10.0	0.025	
Ar	I	377.037	2.0			Zaidel
Y	II	377.433	57.0	10.0	0.0053	
Tl	I	377.572	13.0	100.0	0.230	
Ar	I	378.136	1.3			Zaidel
Y	II	378.870	40.0	10.0	0.0075	
La	II	379.083	26.0	10.0	0.011	
La	II	379.478	30.0	10.0	0.010	
Tm	II	379.575	26.0	10.0	0.011	
Ho	II	379.675	12.0	10.0	0.025	H 379.790
H	I	379.790	0.1			Zaidel
Ce	II	380.152	4.0	10.0	0.075	
Nd	II	380.536	16.0	100.0	0.187	
Ho	II	381.073	15.0	10.0	0.020	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Eu	II	381.967	110.0	10.0	0.0027	
Mg	I	383.231	0.7	1.0	0.042	
Ar	I	383.468	6.0			Zaidel
H	I	383.539	0.1			Zaidel
Mg	I	383.826	0.9	1.0	0.033	
Tm	II	384.802	31.0	10.0	0.0097	
Nd	II	384.824	16.0	100.0	0.187	NR
Nd	II	384.852	16.0	100.0	0.187	NR
Tb	II	384.873	54.0	100.0	0.055	
La	II	384.902	12.0	10.0	0.025	
Nd	II	385.166	19.0	100.0	0.157	NR
Nd	II	385.174	19.0	100.0	0.157	NR
U	II	385.466	6.2	100.0	0.483	
U	II	385.958	12.0	100.0	0.250	
Nd	II	386.333	23.0	100.0	0.130	NR
Nd	II	386.340	23.0	100.0	0.130	NR
La	II	387.164	20.0	10.0	0.015	
Dy	II	387.211	8.2	10.0	0.036	
Tb	II	387.417	48.0	100.0	0.062	
Sm	II	388.529	36.0	100.0	0.083	
H	I	388.905	0.3			Zaidel
Ho	II	389.102	18.0	10.0	0.016	H 388.905
Ba	II	389.178	5.2	10.0	0.057	H 388.905
Ar	I	389.466	1.4			Zaidel
Er	II	389.623	7.0	10.0	0.042	H 388.905
Dy	II	389.853	6.0	10.0	0.050	
Tb	II	389.920	31.0	100.0	0.096	
Ar	I	389.986	1.0			Zaidel
Er	II	390.631	14.0	10.0	0.021	
Eu	II	390.710	39.0	10.0	0.0077	
Pr	II	390.844	8.1	10.0	0.037	
La	II	392.922	12.0	10.0	0.025	
Eu	II	393.048	53.0	10.0	0.0057	
Ce	II	393.109	5.0	10.0	0.060	
U	II	393.203	8.2	100.0	0.365	
Ca	II	393.366	89.0	0.5	0.00019	
Nd	II	394.151	19.0	100.0	0.157	
Ce	II	394.275	4.4	10.0	0.068	
Al	I	394.401	6.3	10.0	0.047	
Dy	II	394.468	9.5	10.0	0.031	
Ar	I	394.750	8.0			Zaidel
Ar	I	394.898	27.0			Zaidel
La	II	394.910	NM	10.0	-----	Ar 394.898
Nd	II	395.116	17.0	100.0	0.176	
Al	I	396.152	10.5	10.0	0.028	
Nd	II	396.312	17.0	100.0	0.176	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Dy	II	396.839	9.5	10.0	0.031	Ca 396.847,H 397.007
Ca	II	396.847	30.0	0.5	0.00050	H 397.007
H	I	397.007	0.6			Zaidel
Eu	II	397.196	32.0	10.0	0.0094	H 397.007
La	II	398.852	27.0	10.0	0.011	
La	II	399.575	22.0	10.0	0.013	
Dy	II	400.045	8.4	10.0	0.035	
Pr	II	400.869	4.6	10.0	0.065	
Nd	II	401.225	59.0	100.0	0.050	
Ce	II	401.239	4.0	10.0	0.075	
Th	II	401.913	36.0	100.0	0.083	
Mn	I	403.076	6.8	10.0	0.044	
La	II	403.169	19.0	10.0	0.015	
Ga	I	403.298	27.0	100.0	0.111	
Mn	I	403.307	6.3	10.0	0.047	
Ce	II	404.076	4.0	10.0	0.075	
Nd	II	404.080	23.0	100.0	0.130	
La	II	404.291	19.0	10.0	0.015	
K	I	404.414	0.0	1000.0	-----	Ar 404.442
Ar	I	404.442	31.0			Zaidel
Ar	I	404.597	2.5			Zaidel
K	I	404.721	0.7	1000.0	42.857	
Ar	I	405.453	1.5			Zaidel
Pb	I	405.783	11.0	100.0	0.272	
Nd	II	406.109	31.0	100.0	0.096	
Pr	II	406.281	6.3	10.0	0.047	
Ce	II	407.571	4.2	10.0	0.071	NR
Ce	II	407.585	4.2	10.0	0.071	NR
La	II	407.735	21.0	10.0	0.014	
Sr	II	407.771	72.0	1.0	0.00042	
Dy	II	407.796	7.5	10.0	0.040	
La	II	408.672	30.0	10.0	0.010	
U	II	409.014	8.9	100.0	0.337	
H	I	410.174	1.5			Zaidel
In	I	410.176	6.4	100.0	0.468	H 410.174
Nd	II	410.946	26.0	100.0	0.115	
Pr	II	411.846	6.0	10.0	0.050	
La	II	412.323	29.0	10.0	0.010	
Eu	II	412.970	70.0	10.0	0.0043	
Ba	II	413.066	9.1	10.0	0.032	
Li	I	413.262	0.4	100.0	7.500	Zaidel,NR
Li	I	413.256	0.4	100.0	7.500	Zaidel,NR
Ce	II	413.380	6.0	10.0	0.050	
Ce	II	413.765	6.2	10.0	0.048	
Pr	II	414.311	8.0	10.0	0.037	
Nd	II	415.608	28.0	100.0	0.107	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Ar	I	415.859	>50.0			Zaidel
Sr	II	416.180	2.4	10.0	0.125	
Ar	I	416.418	17.0			Zaidel
Ga	I	417.206	45.0	100.0	0.066	
Nd	II	417.732	22.0	100.0	0.136	
Y	II	417.754	26.0	10.0	0.011	
Pr	II	417.939	7.2	10.0	0.041	
Ar	I	418.188	28.0			Zaidel
Ce	II	418.660	5.7	10.0	0.052	
Pr	II	418.948	5.0	10.0	0.060	
Ar	I	419.071	32.0			Zaidel,NR
Ar	I	419.103	32.0			Zaidel,NR
Ar	I	419.832	50.0			Zaidel
Ar	I	420.068	50.0			Zaidel
Rb	I	420.185	0.8	1000.0	37.500	
Eu	II	420.505	70.0	10.0	0.0043	
Sr	II	421.552	39.0	1.0	0.00077	
Rb	I	421.556	NM	1000.0	-----	Sr 421.552
Pr	II	422.293	6.3	10.0	0.047	
Pr	II	422.535	7.0	10.0	0.042	
Ca	I	422.673	1.5	0.5	0.010	
U	II	424.167	6.5	100.0	0.461	
Sc	II	424.683	110.0	10.0	0.0027	
Nd	II	424.738	17.0	100.0	0.176	
Ar	I	425.119	7.5			Zaidel
Ar	I	425.936	50.0			Zaidel
Ar	I	426.629	32.0			Zaidel
Ar	I	427.217	43.0			Zaidel
Sm	II	428.079	43.0	100.0	0.069	
Ce	II	429.667	4.3	10.0	0.069	
Ar	I	430.010	40.0			Zaidel
Nd	II	430.358	40.0	100.0	0.075	
Sr	II	430.545	4.8	10.0	0.062	
Sc	II	431.409	38.0	10.0	0.0079	
Sc	II	432.074	31.0	10.0	0.0097	
Sc	II	432.501	19.0	10.0	0.015	
Ar	I	433.356	38.0			Zaidel
Ar	I	433.531	11.0			Zaidel
H	I	434.047	5.0			Zaidel
Ar	I	434.517	9.0			Zaidel
Hg	I	435.835	1.1	100.0	2.727	
Ar	I	436.379	1.0			Zaidel
Ar		436.836	3.2			MIT
Sc	II	437.446	17.0	10.0	0.017	

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Y	II	437.494	46.0	10.0	0.0065	
Pr	II	440.882	4.9	10.0	0.061	
Ar	I	442.399	0.5			Zaidel
Sm	II	442.434	55.0	100.0	0.054	
La	II	442.990	13.0	10.0	0.023	
Sm	II	443.432	36.0	100.0	0.083	
Eu	II	443.556	24.0	10.0	0.012	
Nd	II	445.157	19.0	100.0	0.157	
Ce	II	446.021	4.8	10.0	0.062	
Sm	II	446.734	41.0	100.0	0.073	
Ar	I	451.074	21.0			Zaidel
In	I	451.131	16.0	100.0	0.187	
Ar	I	452.232	6.2			Zaidel
Ba	II	452.493	1.9	10.0	0.157	
Cs	II	452.673	0.7	1000.0	42.857	Zaidel
Ba	II	455.403	230.0	10.0	0.0013	
Cs	I	455.531	0.3	1000.0	100.000	
Ce	II	456.236	4.1	10.0	0.073	
Ar	I	458.929	0.2			Zaidel
Ar	I	459.610	6.0			Zaidel
Li	I	460.286	3.5	100.0	0.857	
Sr	I	460.733	4.4	10.0	0.068	
Ar	I	462.844	4.0			Zaidel
Ar	I	470.232	7.2			Zaidel
Zn	I	472.216	0.7	10.0	0.428	
Ar	I	475.294	1.0			Zaidel
Ar	I	476.867	0.9			Zaidel
Cd	I	479.992	0.5	10.0	0.600	
Zn	I	481.053	1.3	10.0	0.230	
Ar	I	483.669	0.6			Zaidel
H	I	486.133	17.0			Zaidel
Ar	I	487.626	3.2			Zaidel
Ar	I	488.795	3.2			Zaidel
Ar	I	489.469	1.5			Zaidel
Ba	II	489.997	3.7	10.0	0.081	
La	II	492.098	12.0	10.0	0.025	
La	II	492.179	12.0	10.0	0.025	
Ba	II	493.409	130.0	10.0	0.0023	
Ar	I	495.675	0.8			Zaidel
Li	I	497.170	1.4	100.0	2.142	
Ar	I	498.995	0.2			Zaidel
Ar	I	503.203	0.5			Zaidel
Ar	I	504.881	2.6			Zaidel
Ar	I	505.418	1.7			Zaidel
Ar	I	506.008	2.7			Zaidel
Ar	I	507.308	0.6			Zaidel

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Ar	I	508.709	0.6			Zaidel
Ar	I	511.820	2.8			Zaidel
Ar	I	512.780	0.5			Zaidel
Ar	I	515.140	6.0			Zaidel
Ar	I	516.228	18.0			Zaidel
Ar	I	517.754	1.9			Zaidel
Ar	I	518.775	24.0			Zaidel
Ar	I	521.049	0.5			Zaidel
Ar	I	521.477	0.3			Zaidel
Ar	I	522.127	9.0			Zaidel
Ar	I	524.110	0.5			Zaidel
Ar	I	525.279	3.8			Zaidel
Ar	I	525.448	3.2			Zaidel
Ar	I	528.608	0.8			Zaidel
Ar	I	531.773	0.5			Zaidel
Ar	I	534.741	0.3			Zaidel
Ar	I	537.349	1.4			Zaidel
Ar	I	539.397	0.7			Zaidel
Ar	I	541.047	1.4			Zaidel
Ar	I	542.135	6.6			Zaidel
Ar	I	543.999	2.2			Zaidel
Ar	I	544.222	2.5			Zaidel
Ar	I	545.165	15.0			Zaidel
Ar	I	545.742	2.8			Zaidel
Ar	I	547.346	2.3			Zaidel
Ar	I	549.587	31.0			Zaidel
Ar	I	550.611	6.0			Zaidel
Ar	I	552.496	5.0			Zaidel
Ar	I	553.445	0.7			Zaidel
Ar	I	555.870	33.0			Zaidel
Ar	I	555.962	4.9			Zaidel
Ar	I	557.255	21.0			Zaidel
Ar	I	558.183	0.8			Zaidel
Ar	I	558.872	3.5			Zaidel
Ar	I	559.748	3.9			Zaidel
Ar	I	560.108	0.9			Zaidel
Ar	I	560.673	36.0			Zaidel
Ar	I	561.797	1.4			Zaidel
Ar	I	562.089	1.0			Zaidel
Ar	I	562.378	0.4			Zaidel
Ar	I	563.558	0.9			Zaidel
Ar	I	563.911	0.5			Zaidel
Ar	I	564.134	1.0			Zaidel
Ar	I	564.866	1.7			Zaidel
Ar	I	565.070	21.0			Zaidel
Ar	I	565.913	2.4			Zaidel

	S OF I	WAVE-LENGTH (nm)	$\frac{I_n}{I_b}$	CONC (mg/L)	EST'D DET LIM (mg/L)	COMMENTS
Ar	I	568.190	2.8			Zaidel
Ar	I	568.964	2.0			Zaidel
Ar	I	568.991	2.0			Zaidel
Ar	I	570.086	0.7			Zaidel
Ar	I	573.952	15.0			Zaidel
Ar	I	577.212	4.0			Zaidel
Ar	I	580.208	2.8			Zaidel
Ar	I	583.426	6.0			Zaidel
Ar	I	586.032	4.3			Zaidel
Ar	I	588.263	7.1			Zaidel
Ar	I	588.859	25.0			Zaidel
Na	I	588.995	101.0	100.0	0.029	Ar 588.859
Na	I	589.592	43.0	100.0	0.069	
Ar	I	591.200	19.0			Zaidel
Ar	I	592.881	10.0			Zaidel
Ar	I	594.267	2.7			Zaidel

TECHNICAL REPORT DATA
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1. REPORT NO. EPA-600/4-79-017	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Inductively Coupled Plasma-Atomic Emission Spectroscopy: Prominent Lines		5. REPORT DATE March 1979 issuing date 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) R. K. Winge, V. J. Peterson, and V. A. Fassel		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Ames Laboratory, USDOE Iowa State University Ames, Iowa 50011		10. PROGRAM ELEMENT NO. 1CC824 11. CONTRACT/GRANT NO. EPA-IAG-78-D-X0146
12. SPONSORING AGENCY NAME AND ADDRESS Environmental Research Laboratory--Athens, GA Office of Research and Development U.S. Environmental Protection Agency Athens, Georgia 30605		13. TYPE OF REPORT AND PERIOD COVERED Final, 3/77-2/78 14. SPONSORING AGENCY CODE EPA/600/01
15. SUPPLEMENTARY NOTES		

16. ABSTRACT

The prominent lines of 70 elements as emitted in an inductively coupled plasma excitation source have been identified. The lines are listed alphabetically by element and numerically by wavelength. Detection limit capabilities are estimated for each spectral line.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Chemical analysis Spectroscopy Chemical elements		07B 68D

18. DISTRIBUTION STATEMENT RELEASE TO PUBLIC	19. SECURITY CLASS *(This Report)* UNCLASSIFIED 20. SECURITY CLASS *(This page)* UNCLASSIFIED	21. NO. OF PAGES 71 22. PRICE

EPA Form 2220-1 (9-73)

☆ U.S. GOVERNMENT PRINTING OFFICE: 1979-657-060/1608