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A New Method of Analysis for Trace Elements in Gold-Silver Deposits: Comparison with Lake City Data

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ABSTRACT

A new method of analysis has been developed for the elements Ag, As, Au, Bi, Ga, Hg, In, Sb, Sn, Te, and Tl. This method is a high current inert atmosphere semiquantitative DC-arc optical emission spectrographic technique and has the advantages of high sensitivity and simultaneous, rapid determination of a large suite elements on the same sample. Detection limits range from 0.05 ppm for Ag to 3 ppm for As. Analytical results for Ag, As, Au, Bi, Ga, Hg, and Sb by the present method were compared to results on splits of the same samples analyzed by six techniques routinely used by the U.S. Geological Survey (USGS). Correlation coefficients range from 0.75 to 0.93 on sets of 20 or more sample pairs, which is significant at the 99.9 percent confidence level. On average, analyses by the new technique are 30 percent lower than by the standard techniques. Sensitivity for the tested elements is comparable to that of the standard techniques. The results indicate that this method is suitable for regional reconnaissance geochemical exploration. Use of exact sample weights, corrections for variations in background and excitation, and corrections for density differences will increase the accuracy and precision of this method. Potentially, this method can provide quantitative analyses on a wide range of geological materials.

INTRODUCTION

Many laboratory techniques are available for analysis of chemical elements important in geochemical exploration for precious metal deposits, but few have the necessary combination of characteristics to be widely applicable. These characteristics include (1) sufficiently low detection limits, (2) sufficiently high accuracy and precision, (3) optimization of analytical procedures to obtain the best possible results for the elements of interest, (4) low cost, (5) rapid turn-around for large numbers of samples, and (6) simultaneous determinaton of a comprehensive suite of elements.

The method described in this report is specifically designed to meet these six requirements. Eleven elements are analyzed by this technique, Ag, As, Au, Bi, Ga, Hg, In, Sb, Sn, Te, and Tl. The elements Ag, Au, Bi, Hg, and Sn are not only pathfinders for precious metal deposits but, in sufficient quantities, they form commercial ore deposits. The elements As, Ga, In, Sb, Te, and Tl are less important commercially but are very important by virtue of their common association with precious metal and other epithermal ore deposits. The present method is optimized for these eleven elements. "Optimization" in this context means that the instrument characteristics and operating conditions are adjusted to yield the best sensitivity, precision, and accuracy for the element suite of interest (at the expense of less important elements). As shown in the following discussion, the detection limits and accuracy are comparable to other techniques which may typically determine a few, but not all, of these elements. The elements In, Te, and Tl are normally not reported in standard USGS analyses. In order to obtain data on the remaining eight elements analyzed by the present technique, one would have to use six different techniques at considerably greater expense. Like emission spectrographic techniques in general, the present technique is well suited for analysis of large numbers of samples at low cost. However, unlike conventional emission spectrographic techniques, which attempt to measure the widest suite of elements, the present method is adapted to obtain the best results on a specific group of elements having the greatest significance for mineral exploration. Additional elements such as Cd, Ge, Mo, Pb, and Zn are also analyzable but were not included in this investigation.

This study was undertaken to evaluate the usefulness of the technique in studies of the geochemistry of vein and disseminated gold deposits and other hydrothermally altered geologic systems. Because of the comprehensive nature of the geochemical, geological, and geophysical studies of the Lake City caldera (e.g., see Sanford and others, in press), selected samples from this region were ideal for a comparative study.

This paper shows that the technique yields values that are systematically biased to the low side by about 30 percent. Under the existing analytical conditions (sample charges were not weighed nor were there any corrections for excitational variations, background shifts, etc.) this bias is considered to be acceptably small, and we feel the data are of sufficient quality to be used in mineral resource appraisal at the present time. This report specifically accompanies the appraisal of wilderness potential in the Redcloud Peak, Handies Peak, and American Flats Wilderness Study Areas in Hinsdale County, Colorado (Sanford and others, in press; Hon, in press).

DESCRIPTION OF NEW TECHNIQUE

Analyses of geologic materials for most chalcophile elements at trace levels of concentration are typically very labor-intensive, costly, and time-consuming; therefore, there tends to be a paucity of data on the distribution and abundance of these elements in most geochemical studies. A recent development by the second author in DC-arc optical emission spectrography has made it possible to determine these elements simultaneously in silicate matrices at significantly lower levels of detection than before. Eleven chalcophile elements (Ag, As, Au, Bi, Ga, Hg, In, Sb, Sn, Te, and Tl) are particularly suited for determination by this DC-arc technique; all are directly determined simultaneously in 50-60 mg of sample with detection limits generally in the range of 0.05-1 part per million. One sample requires about 30 secs to collect data on all the elements of interest. This improvement has been accomplished by (1) using a high-current (30 amp.) DC arc for excitation in an inert atmosphere (argon), (2) optimizing the excitation parameters of the arc, and (3) optimizing the spectrograph for maximum light efficiency over the wavelength range of 220-330 nm at a reciprocal linear dispersion of 0.25 nm/mm. Spectra are recorded on readily available, comparatively inexpensive Spectrum Analysis No. 1 Kodak* spectroscopic plates. A comparison of the new detection limits with those of the routinely used methods in geochemical studies is given in table 1.

DESCRIPTION OF ROUTINE TECHNIQUES USED IN COMPARISONS

Emission spectrographic semiquantitative (6-step) analysis.--The semiquantitative optical emission spectrographic analysis of geologic materials, as reported by Myers and others (1961), provides a rapid, sensitive, multi-element (68), survey-type analysis of a wide variety of

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*The use of trade names is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.

natural earth materials and is ideal for reconnaissance studies. Samples are analyzed directly as powders with analytical data being generated by visually comparing emission line intensities between samples and synthetic standards. Elemental concentrations in the standards are geometrically distributed over any given order of magnitude of concentration as follows: $1x10^x$, $2x10^x$, $5x10^x$, $10x10^x$, where x typically ranges from -3 to +4. Samples whose concentrations are estimated to fall between those values are assigned intermediate values, i.e., $1.5x10^x$, $3x10^x$, and $7x10^x$. The precision of the analytical method has been reported by Matooka and Grimes (1976), as being plus or minus one reporting interval at the 83 percent confidence level, and plus or minus two reporting intervals at the 96 percent confidence level. For the USGS work in the Wilderness Study Area program, this procedure was modified to evaluate only the 31 elements used in the USGS's exploration geochemical program (Grimes and Marranzino, 1968).

Induction coupled argon plasma-atomic emission spectrometry (ICAP-AES).--For those geologic samples analyzed by induction coupled argon plasma-atomic emission spectrometry, 50 elements are determined simultaneously on multi-acid, low temperature digests of sample materials. Matrix interferences due to spectral line overlap and background shifts are minimized by appropriate background correction and mathematical inter-element corrections. Relative standard deviations (RSD) of semiquantitative data by this method are typically on the order of 15 percent, whereas quantitative data usually represent precision of better than 2 percent RSD. The technique provides for automated, multi-element, highly sensitive, high precision analyses of a variety of geological materials. Detection limits for the most commonly occurring trace elements range from 1-10 ppm. Precision of the major element determinations (Al, Fe, Mg, Ca, Na, K, Ti, P) is adequate for most studies; however, data on Si is not usually reported due to its loss during sample preparation. Description of the multi-channel ICAP-AES polychromator, analytical wavelengths, operating conditions, sample preparation, and accuracy and precision of the method have been reported by Crock and others (1983).

HCl/H_2O_2 extractable Sb, As, Bi, Cd, Cu, Pb, Mo, Ag, and Zn/ICAP-AES (A-Z).--Extractable concentrations of Ag, As, Bi, Cd, Cu, Mo, Pb, and Zn, in geological materials are determined on a hydrochloric acid-hydrogen peroxide (HCl/H_2O_2) digest analyzed by ICAP-AES, Crock and others (1986). The HCl/H_2O_2 sample digestion is a modification of the procedure of O'Leary and Viets (1986), which has been reported to solubilize most non-silicate bound metals found in geologic materials. This extraction solution is analyzed directly for all specific elements simultaneously on a multi-channel ICAP-AES polychromator. The instrument, analytical wavelengths, and operating conditions have been reported by Crock and others (1983). A review of the application of this technique has been reported by Crock and others (1986).

Extractable gold/atomic absorption (XAu/AA).--Au is determined in geological materials by a modification of the procedure of Thompson and others (1968) which uses solvent extraction and atomic absorption spectrophotometry. Ashed samples are digested in HBr/Br_2, the complexed Au is extracted with methyl isobutyl ketone (MIBK), and the Au concentrations are determined by analysis of the MIBK using standard flame atomic absorption procedures. This digestion frees most forms of Au found in nature, the main exception being Au species occluded by silicate phases.

Antimony/hydride generation-flameless atomic absorption (AH/AA).--Trace levels of Sb in geological materials (Crock and Lichte, 1982) are determined via an automated hydride generation-atomic absorption spectroscopic technique. Sample materials are digested in sulfuric, nitric, hydrofluoric, and perchloric acids. A hydrochloric acid solution of the resulting evaporates is mixed with reducing agents, further acidified with hydrochloric acid, and treated with a sodium tetrahydroborate solution to form the volatile hydride, stibine. The hydrides are passed through a gas/liquid separator and decomposed in a heated quartz tube positioned in the optical path of an atomic absorption spectrometer. These absorption measurements are used to calculate concentrations. Interferences are minimized such that most geological materials can be analyzed directly without the use of standard additions. Analytical precision is better than 2 percent RSD at the 50 $\mu g\ l^{-1}$ Sb level.

Mercury/cold vapor cell.--Hg is determined in rocks and other geologic materials (Huffman and others 1972) using a modification of the cold-vapor cell flameless atomic absorption spectrometric methodology originally reported by Hatch and Ott (1968). Powdered samples are digested under oxidizing conditions. Hg is reduced to the elemental state and aerated from solution onto a silver screen where it is amalgamated. The silver screen is subsequently heated, releasing Hg vapor which is then swept through a cold-vapor absorption cell where absorption measurements are taken. The Hg concentrations are calculated from these measurements. An automated continuous-flow version of this methodology has been developed by Crock and others (1986), in which the sample digest is mixed with air and then sequentially with a complexation-reducing solution and a stannous chloride solution, and then passed through a gas-liquid phase separator. Absorption measurements on the mercury vapor are made as previously described. Short-term precision is 1-2 percent RSD; the detection limit is 0.02 ppm Hg.

DESCRIPTION OF SAMPLES

All samples are from epithermal veins in the Lake City area of the San Juan Mountains in southwestern Colorado. The geology of the area has been described by Irving and Bancroft (1911), Lipman and others (1973, 1976), and the mineral deposits have been described by Irving and Bancroft (1911), Brown (1926), Burbank and Luedke (1968), Lipman and others (1976), Slack (1976, 1980), and Krasowski (1976).

Samples are principally of vein quartz with associated sulfides and other minerals. Major vein minerals in order of decreasing abundance are quartz, pyrite, galena, sphalerite, barite, chalcopyrite, tetrahedrite, and rhodochrosite. Minor minerals are sericite, calcite, fluorite, tennantite, arsenopyrite, hematite, ankerite, kaolinite, alunite, argentite, gold, electrum, uraninite, and various sulfosalts, tellurides, and sulfobismuthinides. Many samples contain breccia fragments of wall rock rhyolite and/or andesite. These wall-rock fragments are typically altered to quartz, sericite, and pyrite, and they contain relict trace amounts of Fe-Ti oxides, zircon, apatite, and allanite.

The important Ag minerals in these samples are acanthite, argentiferous tetrahedrite, hessite, and various silver sulfosalts (Irving and Bancroft, 1911; Slack, 1980; Sanford, unpublished data). Au is rarely observed in thin section, but where it is visible, it occurs as gold tellurides, mainly petzite, or as native gold or electrum (Irving and Bancroft, 1911; Slack, 1980; Grauch and others, 1985). The element As occurs in rare tennantite and arsenopyrite; more commonly it substitutes for Sb in tetrahedrite. A variety of bismuth-bearing minerals have been reported, typically only in trace amounts. Aikinite ($PbCuBiS_3$) was reported from the Gladiator Mine (Eckel, 1961), and lillianite ($Pb_3Bi_2S_6$) was found at the Monticello Mine (Brown, 1926). Maltildite ($AgBiS_2$) and schirmerite ($PbAg_4Bi_4S_9$) were reported from the Lake City area by Genth (1886) and Harcourt (1942), respectively, but neither authors give exact locations. Slack (1976, 1980) noted aikinite, bismuthinite (Bi_2S_3), emplectite ($Cu_2Bi_2S_4$), wehrlite (BiTe), and tellurobismuthinite ($BiTe_3$) in mines from the Lake District. Sb is mainly in tetrahedrite which is widespread and in many other less abundant sulfosalts. Sn substitutes for Sb and locally forms colusite, the Sn end-member of the tetrahedrite family (Slack, 1980; Kramer and Sanford, unpublished data). Te occurs in several deposits scattered around the area (Irving and Bancroft, 1911; Slack, 1980; Grauch and others, 1985; Kramer and Sanford, unpublished data). It forms tellurides of Ag, Au, Pb, Bi, Hg, and Ni, as well as native Te and tellurite. The only identified Hg mineral is coloradoite (HgTe) (Slack, 1980). Ga, In, and Tl have not been reported in any mineral species from the area.

SAMPLE PREPARATION

Rock samples, typically 0.5 to 1 kg in weight, are crushed in a jaw-crusher to approximately 20 mesh (0.84 mm) particle size. Representative splits of about 50 g are ground between plates made of high-alumina ceramic to pass a 100-mesh (0.15 mm) sieve. This final grinding may be done using a ceramic-lined "Shatterbox."* In all cases, the grinding apparatus is cleaned between samples to minimize cross-contamination.

COMPARISON OF PRESENT TECHNIQUE WITH STANDARD TECHNIQUES

Analyses by the technique presented here were compared wherever possible to analyses by the standard techniques described above. Results of statistical tests are shown in table 2. In this discussion, we will refer to the values obtained by standard techniques as the "standard value" or simply the "standard." Values by the standard and the new technique were plotted against one another and correlation coefficients computed. Where at least 80 percent of the sample pairs had both values unqualified (no <'s or >'s), the correlation coefficients were tested for significance using table 7 of Crow and others (1960). Where 20 or more samples were compared, the correlation coefficients of the "raw" data vary from 0.72 to 0.90 and of the "log-transformed" data, from 0.75 to 0.93. These correlations are significant at the 99.9 percent confidence level for sets having at least 80 percent unqualified pairs.

To evaluate bias, deviations consistently higher or lower than the standard, the number of values above and below the standard were tabulated (table 2, cols. 6, 7, and 8). Differences between standard and present technique (absolute deviation) as well as the ratio of this difference to the standard (relative deviation) were calculated for each sample. The absolute deviation was plotted against the standard value for each element. These plots showed that the absolute deviation is roughly proportional to the amount present and consequently the relative deviation is a constant for each technique. Therefore, evaluation of these data used the relative deviation, the median values of which are shown in table 2, column 9. A relative deviation ratio of -0.57, for example, means that analyses by the present technique are 57 percent lower than those by the standard technique; a relative deviation of +0.25, for example, means that the present technique gives values 25 percent higher than the standard. Both median and mean values of the relative deviations were calculated. For many elements, the mean of the relative deviations was highly skewed by one or a few very high or low values. Consequently, we chose to use the median of the relative deviation as the best measure of the typical relative deviation.

Detection limits.--Comparisons of stated detection limits are shown in table 1. Except for Au, Hg, and Sb, all of the elements are detected in smaller amounts by the present technique than are reported by standard USGS techniques. Even for Au, the detection limit by the present technique is only slightly higher than that for AA. In, Tl, and Te are not reported at all by standard techniques.

The elements are discussed below in order of decreasing value of the comparisons, that is, in order of decreasing accuracy and sensitivity of the standard and of decreasing number of replicate analyses.

Gold.--Gold by the present method is compared to gold by XAu/AA (table 3). Gold by XAu/AA probably gives the most accurate values of all the standard techniques discussed and therefore gives one of the most valuable comparisons. The correlation coefficients of 0.79 and 0.77 (table 2, cols. 4 and 5) for "raw" and "log-transformed" data, respectively, are typical of the comparisons of the other elements having more than 20 unqualified pairs of values. These correlations are very high but cannot be legitimately tested for significance because only the 24 pairs of samples that contain two unqualified values were used in computing the correlations, and there are a total of 46 pairs in the sample set. The median relative deviation of -0.60 (table 2, col. 9) is worse in the direction of being lower than the weighted mean of the median values (-0.30 in table 2, col. 9). Eighteen of the samples are too low relative to the standard, whereas only 6 are too high. Values range from being low by 91 percent to high by 150 percent (table 2, cols. 11 and 10, respectively).

Comparison of detection limits shows reasonable agreement with XAu/AA (table 3). In 21 samples, gold is reported by the present method as less than 0.2 ppm. In 16 of those 21 cases (76 percent), the XAu/AA value reported was 0.2 ppm or less; in 20 cases (95 percent), the XAu/AA value was 0.5 ppm or less; and in one case, the XAu/AA value was 1.5 ppm. Conversely, of the 19 samples having gold by XAu/AA less than or equal to 0.2 ppm, 17 were also less than or equal to 0.2 ppm, one was 0.3 ppm, and another was 0.5 ppm by the present method. Thus there is reasonable agreement between XAu/AA and the present method in discriminating beween samples above and below the respective detection limits.

Silver.--Silver was analyzed by 6-step (table 4) and ICAP-AES (table 5). The relatively large number of unqualified duplicate samples analyzed by both 6-step and the present technique makes this also one of the most valuable comparisons. However, both 6-step and the ICAP-AES procedure used in this study are semiquantitative techniques, so we cannot expect as close a comparison as one with a quantitative technique.

The 6-step and ICAP-AES techniques both yield similar results when compared with the present technique. However, the comparison with 6-step is more valuable because of the larger number of samples. The correlation coefficients of 0.82 and 0.93 (table 2) with the 6-step method for "raw" and "log-transformed" data are excellent and are significant at the 99.9 percent confidence level. These correlations are comparable to those of As and somewhat higher than those for Au (although Au has too many qualified values to make a strict comparison). The median value of the relative deviation for silver by 6-step is close to the weighted mean of the median relative deviation for all the elements (0.30, table 2, col. 9). The tendency for systematically low values can also be seen in the number of values that are too high (15, table 2, col. 6) compared to the number of values that are too low (66, table 2, col. 8). Comparison with the much smaller set of ICAP-AES values also shows high correlations at the 99.9 percent confidence level, but there is greater bias move toward lower values. Thus silver reliability may be considered typical to better-than-average for this technique.

In order to test the relative accuracy of the detection limit of 0.1 ppm for this method, we compared the values which were below detection limits of the present method with similar values by 6-step. Of the three sample having less than 0.1 ppm by the present method, two showed less than 0.5 ppm and one showed 1.0 ppm by 6-step. One sample out of three is seriously in disagreement, but there are too few samples to make any significant generalizations. Conversely, of the ten values reported by 6-step as less than 0.5 ppm, all were 0.2 ppm or less by the new method. Even adjusting for the new values being 33 percent too low, as discussed above, these data agree well. Based on the limited data available there seems to be reasonable agreement between values at or below the detection limits.

Arsenic.--Arsenic analyses were compared by three methods. Two of these techniques, ICAP-AES (table 6) and A-Z (table 7), have many more samples and are thus much more valuable. The correlation coefficients (table 2, cols. 4 and 5) are uniformly high and are significant at the 99.9 percent confidence level. Thus, correlations for As are comparable to those for Ag and somewhat higher than those for Au (although Au has too many qualified values to make a strict comparison).

The comparisons with ICAP-AES and A-Z show very different bias. The present method is low compared to each of the other methods; however, the present method is much lower in comparison to ICAP-AES than to A-Z. We do not have direct comparisons on duplicate samples between ICAP-AES and A-Z, but the evidence suggests that the A-Z numbers for As would be systematically lower than the ICAP-AES numbers for the same samples. Similarly, both Bi and Sb show a similar tendency for A-Z analyses to be lower than ICAP-AES, 6-step, or AH/AA methods. Probably the lower A-Z values are due to partial rather than complete leaching during sample dissolution, as discussed above in the description of the A-Z technique. If we disregard the comparison with A-Z values as being biased toward too good agreement with the present method, then the present method is only reporting about 21 percent of the arsenic present as determined by ICAP-AES.

Antimony.--AH/AA chemistry (table 8) is expected to give the most accurate results of the three techniques for Sb (table 9). The large number of comparisons with the A-Z technique gives relatively high confidence in the correlation; however, the A-Z values may be systematically low as discussed above for As. Comparisons with Sb by 6-step are the least significant of the three methods because of the smaller number of duplicate samples and the semiquantitative nature of the technique.

As observed for As, the A-Z technique for Sb appears to be systematically low. There is such a difference that the present method is high compared to A-Z by about 25 percent, whereas it is low compared to AH/AA by about 72 percent. Compared to AH/AA, the present technique yields 15 values that are too low and only 3 that are too high. Thus the better method of comparison indicates that the present method underestimates the amount of antimony present.

Mercury.--Hg by the cold vapor cell method (table 10) yields the atypical result that the present method overestimates the amount present. Only antimony by A-Z gives this same result. Even disregarding the one sample that shows extreme discrepancy in Hg, there are three times as many sample that are too high than are too low.

Bismuth.--Comparisons with bismuth by ICAP-AES (table 11), 6-step (table 15), and A-Z (table 12) show excellent correlations; however, relatively few values are above detection limits. Correlation coefficients range from 0.73 to 0.95 (table 2, cols. 4 and 5). The A-Z method tends to make the present technique appear higher than it should, as discussed above. Comparisons with ICAP-AES and 6-step show that the present method is low by about 63-67 percent compared to the standard value (table 2, col. 7).

Gallium.--Ga by ICAP-AES (tables 2 and 13) shows no significant correlation due to large scatter and few duplicate samples. More samples are low than are high by the present technique compared to the standard, showing that Ga also tends to be underestimated by the present technique.

Summary.--The present technique shows good to excellent correlation with other techniques for the elements Au, Ag, As, Hg, Sb, and Bi. On the basis of very limited data, Ga appears not to be reliably determined by the present method. Unfortunately, all elements except possibly Hg tend to be low by 30 to 80 percent depending on the element and method compared. Detection limits appear to be reasonable in comparisons with other techniques. All of the data by the present method are presented in table 14.

DISCUSSION OF BIAS AND SUGGESTIONS FOR FURTHER DEVELOPMENT

The proposed analytical procedure, in its present form, is semiquantitative with many options available to improve its precision, accuracy, and sensitivity. The analytical data generated for this preliminary study was based on sample charges of approximately 60 mg, as no attempt was made to use exact sample weights. Also, no attempts were made to correct for background variations or for variations in excitation. The procedure has been developed for the greatest sensitivity and utility, with data for all the elements of interest being recorded in 30 seconds. Sample information was compared directly with synthetic standards made up in a silicate matrix. Because most of the samples of the suite selected for this study contain abundant sulfide minerals, and because the samples were merely hand-packed into the electrodes used for analysis, density differences between sample charges even play a part in this study. Yet, with all these variables uncontrolled, the data exhibited only approximately a 30 percent low bias. For a semiquantitative analytical technique, which typically yields a precision of plus or minus 50 percent at the 67 percent confidence level, this procedure even in its developmental stage appears adequately to represent the geochemistry of these elements in this study area.

APPLICATION OF NEW TECHNIQUE TO EXPLORATION

More work needs to be done on this technique to eliminate the systematic bias. In the meantime, the data are usable in a limited manner. Because the normal crustal abundance of these elements is about equal to or much lower than the detection limits, and because the present method tends to underestimate the amount present, the detection of anomalous amounts is probably reliable. Errors would tend to be in the direction of missing low-level anomalies rather than giving false indications of nonexistent anomalies. Also, trends and relative abundances can be determined as long as data of only one method are used.

One of the advantages of this technique is that several elements can be analyzed for that are not routinely reported. These include tellurium, tin, indium, and thallium, which we have not tested because of a lack of duplicate analyses at the same levels of sensitivity. We plan to carry out limited comparisons on these elements by other more specialized techniques where possible. In the meantime, we believe that the results using the tested elements discussed above will be applicable to the other, untested elements within similar margins of error.

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Table 1. Comparison of stated determination limits (ppm) by method

Element	This method	ICAP-AES*	6-step	A-Z	Au/AA	CVC	AH/AA
Elements compared in this study							
Ag	0.1	4	0.5				
As	5	20	700	5			
Au	0.2	20	15		0.1		
Bi	0.5	20	10	2			
Ga	0.5	8					
Hg	0.3					0.02	
In	0.5	Not determined					
Sb	5		100	2			0.1
Sn	1	40	10				
Te	3	Not determined					
Tl	0.3	Not determined					
Other elements							
Cd	0.1	4	30	0.1			
Ge	0.2	Not determined					
Mo	1	4	5				
Pb	0.3	10	10				
Zn	1	40	2	2			

*Abbreviations: ICAP-AES, inductively coupled argon plasma emission spectroscopy; 6-step, DC-arc atomic emission spectroscopy; A-Z, $HCl\text{-}H_2O_2$ extraction, ICAP-AES; Au/AA, extractable gold/atomic absorption; CVC, cold vapor cell; AH/AA, antimony hydride generation-flameless atomic absorption.

Table 2. Summary of statistics for all elements tested

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Au	XAu/AA	46	24	.79	.77	6	0	18	-.60	1.50	-.91
	ICAP-AES	11	1	--		0	0	1	-.80	-.80	-.80
Ag	ICAP-AES	9	9	.83**	.84**	1	0	8	-.57	2.33	-.93
	6-step	108	97	.82**	.93**	15	16	66	-.33	4.00	-.86
As	ICAP-AES	47	44	.82**	.75**	2	1	41	-.79	2.23	-.97
	6-step	108	6	--	--	0	1	5	-.54	.0	-.67
	A-Z	108	93	.90**	.89**	27	6	60	-.17	1.90	-.84
Sb	AH/AA	18	18	--	.64	3	0	15	-.72	4.88	-.99
	6-step	108	16	--	--	4	1	11	-.33	2.33	-.80
	A-Z	108	75	.72	.77	47	5	23	.25	15.67	-.92
Hg	CVC	11	9	.90	--	7	0	2	.25	59.00	-.50
Bi	ICAP-AES	47	11	.95	.42	2	0	9	-.63	1.50	-.99
	6-step	108	9	--	.79	0	0	9	-.67	-.33	-.87
	A-Z	108	21	.73	.82	4	0	17	-.55	1.50	-.88
Ga	ICAP-AES	8	8	--	--	1	0	7	-.74	2.00	-1.00
Totals		441		119	30	292					
Weighted Mean							-.30				

(1) Standard method used in comparison. Abbrevations: ICAP-AES, inductively coupled argon plasma emission spectrometry; 6-step, emission spectrographic semiquantitative six-step analysis; A-Z, HCl/H_2O_2 extractable Sb, As, Bi, Cd, Cu, Pb, Mo, Ag, and Zn/ICAP-AES; XAu/AA, extractable gold/atomic absorption; CVC, mercury/cold vapor cell; AH/AA, antimony/hydridide generation-flameless atomic absorption.
(2) Total number of pairs.
(3) Number of unqualified (no "<" or ">" qualifiers) pairs of values compared.
(4) Correlation coeficient based on unqualified values only.
(5) Correlation coefficient of "log-transformed" data, unqualifed values only.
(6) Number of values higher than the standard values.
(7) Number of values equal to the standard values.
(8) Number of values lower than the standard values.
(9) Median value of the relative deviation ([present technique minus standard] divided by [standard]). Positive values indicate that the analyses by the present technique are too high; negative values indicate too low. Negative ratios may range from 0 to -1.00, positive ratios, from 0 to infinity.
(10) Maximum value of the above ratio.
(11) Minimum value of the above ratio.
** Significant at 99 percent confidence level. No asterisks indicates that more than 20 percent of the values are qualified and the significance test was not applied.
-- Not significant at 99 percent confidence level.

Table 3. Gold by ICAP-AES and XAu/AA (ppm).

Sample	(1) Au by ICAP-AES	(2) Au by XAu/AA	(3) Au by this method	(4) This method minus XAu/AA	(5) Ratio of (4) to (2)
2K12B M	--	19.0	10.0	-9.0	-.4737
0G12A2 J	50	17.0	10.0	-7.0	-.4118
0G12A1 J	<20	12.0	5.0	-7.0	-.5833
1K40 B	--	12.0	3.0	-9.0	-.7500
2K90HA G	<20	6.2	2.0	-4.2	-.6774
2K90D1BJ	<20	5.1	2.0	-3.1	-.6078
2K13A M	--	5.0	10.0	5.0	1.0000
2K13A2 M	--	4.8	5.0	.2	.0417
2B11I A	--	3.4	.3	-3.1	-.9118
2K11A M	--	3.0	5.0	2.0	.6667
2B10C A	--	2.2	.5	-1.7	-.7727
2B23A A	--	2.1	1.5	-.6	-.2857
1K89G A	--	2.0	.5	-1.5	-.7500
2K 8 M	--	1.5	.4	-1.1	-.7333
1S28C J	<20	1.5	<.2	--	--
2B21A A	--	1.4	.2	-1.2	-.8571
2K15A M	--	1.2	.5	-.7	-.5833
2K90IA G	<20	1.1	.2	-.9	-.8182
2B25A A	--	1.0	.2	-.8	-.8000
2B25B A	--	1.0	.2	-.8	-.8000
1S83C J	<20	.9	2.0	1.1	1.2222
1K55 B	--	.7	.2	-.5	-.7143
1S28E J	<20	.5	<.2	--	--
2K28A M	--	.5	<.2	--	--
2K27 M	--	.4	.2	-.2	-.5000
1K 6 B	--	.4	<.2	--	--
1K28B B	--	.4	<.2	--	--
2K30 M	--	.2	.5	.3	1.5000
2K26C M	--	.2	.3	.1	.5000
1S29F K	<20	.2	<.2	--	--
2B18A M	--	.2	<.2	--	--
1K30A B	--	.1	<.2	--	--
2B 7C A	--	.1	<.2	--	--
2K11B M	--	.1	<.2	--	--
2K26A M	--	.1	<.2	--	--
2K26D M	--	.1	<.2	--	--
2K29 M	--	.1	<.2	--	--
2K90FG J	<20	<.1	.2	--	--
1S83D K	20	<.1	<.2	--	--
1K95B B	--	<.1	<.2	--	--
1K95CHAB	--	<.1	<.2	--	--
1K95E B	--	<.1	<.2	--	--
1K95G B	--	<.1	<.2	--	--
1K95L B	--	<.1	<.2	--	--
1K95P B	--	<.1	<.2	--	--
1K95R B	--	<.1	<.2	--	--
2K 9B C	--	--	<.2	--	--

(1) P.H. Briggs, analyst; (2) V. Merritt and J. Crock, analysts.
--, Not analysed.

Table 4. Silver by 6-step (ppm).

Sample	(1) Ag by 6-step	(2) Ag by this method	(3) This method minus 6-step	(4) Ratio of (3) to (1)
HP262D	200.0	200.0	.0	.0
RP455I	200.0	100.0	-100.0	-.5000
RP363D	150.0	200.0	50.0	.3333
HP260D	150.0	100.0	-50.0	-.3333
RP415D	150.0	100.0	-50.0	-.3333
HP142H	150.0	50.0	-100.0	-.6667
HP144H	150.0	50.0	-100.0	-.6667
RP453H	150.0	50.0	-100.0	-.6667
RP362C	100.0	200.0	100.0	1.0000
RP371H	100.0	200.0	100.0	1.0000
RP253C	100.0	100.0	.0	.0
RP453I	100.0	50.0	-50.0	-.5000
RP328H	70.0	100.0	30.0	.4286
HP123H	70.0	50.0	-20.0	-.2857
HP146H	70.0	50.0	-20.0	-.2857
RP448H	70.0	50.0	-20.0	-.2857
RP455D	50.0	50.0	.0	.0
RP366C	30.0	50.0	20.0	.6667
RP371C	30.0	50.0	20.0	.6667
RP322C	30.0	30.0	.0	.0
RP450C	30.0	30.0	.0	.0
HP264D	30.0	20.0	-10.0	-.3333
HP135F	30.0	10.0	-20.0	-.6667
HP400C	30.0	5.0	-25.0	-.8333
RP344F	20.0	50.0	30.0	1.5000
RP419D	20.0	20.0	.0	.0
HP129F	20.0	10.0	-10.0	-.5000
RP315C	15.0	50.0	35.0	2.3333
RP374C	15.0	30.0	15.0	1.0000
HP104C	15.0	20.0	5.0	.3333
RP431A	15.0	20.0	5.0	.3333
RP313C	15.0	10.0	-5.0	-.3333
RP331C	15.0	10.0	-5.0	-.3333
RP356G	15.0	10.0	-5.0	-.3333
RP431G	10.0	10.0	.0	.0
HP122C	10.0	5.0	-5.0	-.5000
HP125C	10.0	5.0	-5.0	-.5000
HP138C	10.0	5.0	-5.0	-.5000
RP404C	10.0	5.0	-5.0	-.5000
RP454H	10.0	5.0	-5.0	-.5000
HP141C	10.0	3.0	-7.0	-.7000
HP261D	10.0	2.0	-8.0	-.8000
RP254C	7.0	7.0	.0	.0
RP318C	7.0	7.0	.0	.0
RP411C	7.0	7.0	.0	.0
RP331F	7.0	5.0	-2.0	-.2857
RP377C	7.0	5.0	-2.0	-.2857
HP134F	7.0	3.0	-4.0	-.5714
RP449C	7.0	2.0	-5.0	-.7143
RP404G	7.0	1.0	-6.0	-.8571

Table 4. Continued.

Sample	(1)	(2)	(3)	(4)
RP453J	5.0	5.0	.0	.0
HP105C	5.0	2.0	-3.0	-.6000
HP116C	5.0	2.0	-3.0	-.6000
HP149C	5.0	2.0	-3.0	-.6000
RP448C	5.0	1.0	-4.0	-.8000
HP148C	5.0	.7	-4.3	-.8600
RP319C	3.0	7.0	4.0	1.3333
HP118F	3.0	2.0	-1.0	-.3333
RP314C	3.0	2.0	-1.0	-.3333
RP376C	3.0	2.0	-1.0	-.3333
HP108H	3.0	1.0	-2.0	-.6667
HP111C	3.0	1.0	-2.0	-.6667
HP114C	3.0	1.0	-2.0	-.6667
HP126C	3.0	1.0	-2.0	-.6667
HP150C	3.0	1.0	-2.0	-.6667
RP251C	3.0	1.0	-2.0	-.6667
RP377L	3.0	1.0	-2.0	-.6667
RP328L	3.0	.7	-2.3	-.7667
RP365L	2.0	10.0	8.0	4.0000
HP400G	2.0	5.0	3.0	1.5000
RP255C	2.0	2.0	.0	.0
RP316C	2.0	2.0	.0	.0
RP329C	2.0	2.0	.0	.0
RP361C	2.0	2.0	.0	.0
HP127C	2.0	1.0	-1.0	-.5000
RP364A	2.0	1.0	-1.0	-.5000
HP107C	2.0	.5	-1.5	-.7500
HP151C	2.0	.5	-1.5	-.7500
RP354L	1.5	2.0	.5	.3333
HP128L	1.5	.5	-1.0	-.6667
RP252C	1.5	.5	-1.0	-.6667
RP373C	1.5	.5	-1.0	-.6667
HP112C	1.5	.3	-1.2	-.8000
RP311C	1.0	1.0	.0	.0
HP130C	1.0	.2	-.8	-.8000
RP413G	1.0	.2	-.8	-.8000
AF400C	1.0	<.1	--	--
RP310C	.7	.5	-.2	-.2857
RP341C	.7	.5	-.2	-.2857
RP361G	.7	.5	-.2	-.2857
RP370C	.7	.5	-.2	-.2857
RP453M	.7	.3	-.4	-.5714
RP326C	.7	.2	-.5	-.7143
RP354C	.7	.2	-.5	-.7143
RP406C	.7	.2	-.5	-.7143
RP410C	.7	.2	-.5	-.7143
RP345L	.5	.3	-.2	-.4000
RP343C	.5	.2	-.3	-.6000
RP443C	<.5	.2	--	--
RP444C	<.5	.2	--	--

Table 4. Continued.

Sample	(1)	(2)	(3)	(4)
AF404C	<.5	.1	--	--
RP400C	<.5	.1	--	--
RP401G	<.5	.1	--	--
RP411G	<.5	.1	--	--
RP413C	<.5	.1	--	--
RP442G	<.5	.1	--	--
AF401C	<.5	<.1	--	--
RP453T	<.5	<.1	--	--

(1) M. Malcolm and L. Bradley, analysts.
--, Not analysed.

Table 5. Silver by ICAP-AES (ppm).

Sample	(1) Ag by ICAP-AES	(2) Ag by this method	(3) This method minus ICAP-AES	(4) Ratio of (3) to (1)
0G12A2 J	10,000	1,000	-9,000	-.9000
1S29F K	3,000	1,000	-2,000	-.6667
0G12A1 J	700	50	-650	-.9286
2K90D1BJ	500	300	-200	-.4000
1S83C J	150	30	-120	-.8000
1S28C J	70	30	-40	-.5714
2K90FG J	70	30	-40	-.5714
1S28E J	30	100	70	2.3333
1S83D K	30	20	-10	-.3333

(1) P.H. Briggs, analyst.

Table 6. Arsenic by ICAP-AES (ppm).

Sample	(1) As by ICAP-AES	(2) As by this method	(3) This method minus ICAP-AES	(4) Ratio of (3) to (1)
2K90HA G	4,900	1,000	-3,900	-.7959
2B25B A	4,100	700	-3,400	-.8293
1K 6 B	3,400	1,000	-2,400	-.7059
2B25A A	3,100	1,000	-2,100	-.6774
2K 9B C	2,000	1,000	-1,000	-.5000
2K28A M	1,600	500	-1,100	-.6875
1S28C J	1,600	50	-1,550	-.9688
2K11A M	1,200	700	-500	-.4167
2K 8 M	1,200	200	-1,000	-.8333
2K30 M	1,100	500	-600	-.5455
0G12A1 J	530	50	-480	-.9057
1S28E J	410	100	-310	-.7561
2K12B M	370	200	-170	-.4595
2K90D1BJ	290	100	-190	-.6552
2K13A M	260	200	-60	-.2308
1S83C J	250	200	-50	-.2000
1K28B B	200	20	-180	-.9000
1K95P B	200	20	-180	-.9000
1K95L B	190	15	-175	-.9211
2B11I A	180	30	-150	-.8333
2B21A A	170	15	-155	-.9118
0G12A2 J	160	50	-110	-.6875
2B10C A	160	10	-150	-.9375
1K95R B	150	20	-130	-.8667
1K95E B	140	30	-110	-.7857
2B23A A	130	50	-80	-.6154
2K13A2 M	120	100	-20	-.1667
2K15A M	120	15	-105	-.8750
2K26D M	110	50	-60	-.5455
2K26A M	110	20	-90	-.8182
1S29F K	100	100	0	.0
2B 7C A	100	20	-80	-.8000
1K30A B	100	10	-90	-.9000
2K90FG J	90	500	410	4.5556
2K26C M	80	20	-60	-.7500
1K55 B	70	10	-60	-.8571
1K95G B	70	10	-60	-.8571
1K95CHAB	60	5	-55	-.9167
2K27 M	40	10	-30	-.7500
1K95B B	40	5	-35	-.8750
2K90IA G	30	700	670	22.3333
1K89G A	30	20	-10	-.3333
1K40 B	30	5	-25	-.8333
2K11B M	30	5	-25	-.8333
1S83D K	<20	10	--	--
2K29 M	<20	10	--	--
2B18A M	<20	5	--	--

(1) P.H. Briggs, analyst.
--, Not analysed.

Table 7. Arsenic by 6-step and A-Z (ppm).

Sample	(1) As by 6-step	(2) As by A-Z	(3) As by this method	(4) This method minus A-Z	(5) Ratio of (4) to (2)
HP108H	2,000	9,200	>1,000	--	--
HP146H	1,500	2,200	1,000	-1,200	-.5455
HP261D	1,500	1,600	750	-850	-.5313
HP128L	1,500	1,500	500	-1,000	-.6667
RP328H	1,000	1,200	1,000	-200	-.1667
RP309L	700	840	--	--	--
HP142H	1,500	800	500	-300	-.3750
RP365L	<700	630	100	-530	-.8413
RP345L	700	570	300	-270	-.4737
RP455I	<700	550	500	-50	-.0909
RP328L	<700	490	200	-290	-.5918
RP253C	<700	420	300	-120	-.2857
RP251C	<700	410	200	-210	-.5122
HP148C	<700	400	200	-200	-.5000
RP377L	<700	340	150	-190	-.5588
RP350G	<700	340	--	--	--
HP134F	<700	270	200	-70	-.2593
RP354C	<700	270	100	-170	-.6296
RP254C	<700	260	300	40	.1538
RP431G	<700	260	200	-60	-.2308
RP252C	<700	260	100	-160	-.6154
HP112C	<700	250	200	-50	-.2000
HP114C	<700	240	300	60	.2500
HP150C	<700	230	200	-30	-.1304
RP341C	<700	230	75	-155	-.6739
RP353C	<700	210	--	--	--
RP362C	<700	200	200	0	.0
RP371H	<700	200	200	0	.0
RP331F	<700	190	200	10	.0526
RP310C	<700	180	200	20	.1111
RP361G	<700	180	50	-130	-.7222
HP105C	<700	170	100	-70	-.4118
HP135F	<700	170	100	-70	-.4118
HP400G	<700	170	50	-120	-.7059
HP151C	<700	160	150	-10	-.0625
RP322C	<700	160	75	-85	-.5313
HP147H	<700	160	--	--	--
RP344F	<700	150	200	50	.3333
HP118F	<700	150	150	0	.0
RP319C	<700	150	150	0	.0
RP363D	<700	140	200	60	.4286
HP107C	<700	140	100	-40	-.2857
HP149C	<700	140	100	-40	-.2857
RP351G	<700	140	--	--	--
RP250C	<700	130	--	--	--
HP122C	<700	120	200	80	.6667
HP125C	<700	120	100	-20	-.1667
HP119F	<700	120	--	--	--
HP104C	<700	110	100	-10	-.0909
RP311C	<700	110	100	-10	-.0909

Table 7. Continued.

Sample	(1)	(2)	(3)	(4)	(5)
RP455D	<700	110	100	-10	-.0909
RP453H	<700	110	30	-80	-.7273
RP351C	<700	110	--	--	--
RP369C	<700	110	--	--	--
HP262D	<700	100	150	50	.5000
RP331C	<700	100	100	0	.0
HP111C	<700	94	100	6	.0638
HP129F	<700	91	100	9	.0989
HP141C	<700	90	100	10	.1111
RP371C	<700	90	100	10	.1111
RP373C	<700	89	50	-39	-.4382
RP365C	<700	88	--	--	--
RP404G	<700	86	50	-36	-.4186
HP400C	<700	85	100	15	.1765
HP138C	<700	83	75	-8	-.0964
HP130C	<700	77	50	-27	-.3506
HP116C	<700	76	100	24	.3158
AF102F	<700	76	--	--	--
RP376C	<700	73	50	-23	-.3151
HP126C	<700	72	20	-52	-.7222
HP123H	<700	69	200	131	1.8986
RP326C	<700	66	50	-16	-.2424
RP352C	<700	66	--	--	--
RP377C	<700	63	75	12	.1905
RP342C	<700	63	--	--	--
RP366C	<700	62	50	-12	-.1935
RP404C	<700	61	50	-11	-.1803
RP448H	<700	58	75	17	.2931
HP127C	<700	56	75	19	.3393
RP450C	<700	53	100	47	.8868
RP305C	<700	53	--	--	--
RP431A	<700	52	100	48	.9231
RP406C	<700	52	50	-2	-.0385
RP361C	<700	49	50	1	.0204
RP347G	<700	48	--	--	--
RP370C	<700	46	50	4	.0870
RP364A	<700	45	20	-25	-.5556
RP410C	<700	42	50	8	.1905
RP356G	<700	40	50	10	.2500
RP411G	<700	40	10	-30	-.7500
RP346A	<700	38	--	--	--
RP359C	<700	38	--	--	--
RP355C	<700	35	--	--	--
RP255C	<700	34	50	16	.4706
RP401G	<700	34	10	-24	-.7059
RP415D	<700	33	30	-3	-.0909
RP374C	<700	33	20	-13	-.3939
RP329C	<700	32	10	-22	-.6875
RP325C	<700	31	--	--	--
RP315C	<700	30	30	0	.0

Table 7. Continued.

Sample	(1)	(2)	(3)	(4)	(5)
RP449C	<700	27	20	-7	-.2593
RP442G	<700	27	5	-22	-.8148
HP145C	<700	27	--	--	--
RP318C	<700	24	20	-4	-.1667
RP313C	<700	22	20	-2	-.0909
RP316C	<700	21	20	-1	-.0476
RP314C	<700	20	30	10	.5000
RP443C	<700	19	7	-12	-.6316
RP358C	<700	19	--	--	--
HP144H	<700	18	10	-8	-.4444
RP343C	<700	14	10	-4	-.2857
RP354L	<700	13	10	-3	-.2308
AF101C	<700	13	--	--	--
RP334C	<700	13	--	--	--
RP335C	<700	13	--	--	--
RP448C	<700	12	10	-2	-.1667
HP109C	<700	12	--	--	--
RP375A	<700	12	--	--	--
RP413G	<700	8	5	-3	-.3750
HP132C	<700	8	--	--	--
RP147C	<700	8	--	--	--
RP302C	<700	8	--	--	--
RP306C	<700	8	--	--	--
RP348C	<700	8	--	--	--
RP453J	<700	7	<5	--	--
RP300F	<700	7	--	--	--
RP453I	<700	6	10	4	.6667
RP308A	<700	6	--	--	--
HP260D	<700	<5	100	--	--
HP264D	<700	<5	50	--	--
RP419D	<700	<5	30	--	--
RP411C	<700	<5	5	--	--
AF400C	<700	<5	<5	--	--
AF401C	<700	<5	<5	--	--
AF404C	<700	<5	<5	--	--
RP400C	<700	<5	<5	--	--
RP413C	<700	<5	<5	--	--
RP444C	<700	<5	<5	--	--
RP453M	<700	<5	<5	--	--
RP453T	<700	<5	<5	--	--
RP454H	<700	<5	<5	--	--
HP113C	<700	<5	--	--	--
RP303F	<700	<5	--	--	--
RP378A	<700	<5	--	--	--
RP379A	<700	<5	--	--	--
RP380C	<700	<5	--	--	--

(1) L. Bradley and M. Malcolm, analysts; (2) P. Briggs, analyst.
--, Not analysed.

Table 8. Antimony by hydride/AA (ppm).

Sample	(1) Sb by AH/AA	(2) Sb by this method	(3) This method minus AH/AA	(4) ratio of (3) to (1)
2K90HA G	3,400	1,000	-2,399	-.7059
1S29F K	2,450	100	-2,349	-.9592
0G12A1 J	2,100	500	-1,599	-.7619
2K90D1BJ	1,100	100	-999	-.9091
1S83C J	750	5	-744	-.9933
0G12A2 J	580	500	-79	-.1379
1S28C J	330	300	-29	-.0909
2K90FG J	310	500	190	.6129
1K95L B	180	30	-149	-.8333
2K90IA G	170	1,000	830	4.8824
1S28E J	140	500	360	2.5714
1K95E B	80	50	-29	-.3750
1K95CHAB	46	10	-35	-.7826
1K95G B	44	10	-33	-.7727
1K95B B	34	5	-28	-.8529
1K95R B	32	20	-11	-.3750
1S83D K	26	10	-15	-.6154
1K95P B	19	5	-13	-.7368

(1) V. Merritt and J.G. Crock, analysts.

Table 9. Antimony by 6-step and A-Z (ppm).

Sample	(1) Sb by 6-step	(2) Sb by A-Z	(3) Sb by this method	(4) This method minus A-Z	(5) Ratio of (4) to (2)
RP328H	7,000	3,800	>1,000	--	--
RP455I	5,000	3,100	>1,000	--	--
RP371H	3,000	1,500	>1,000	--	--
RP453H	500	450	100	-350	-.7778
HP260D	700	440	500	60	.1364
HP108H	300	360	1,000	640	1.7778
RP455D	200	200	200	0	.0
RP331C	200	180	500	320	1.7778
RP448H	300	170	200	30	.1765
RP328L	300	160	200	40	.2500
RP431G	150	100	100	0	.0
RP356G	200	98	500	402	4.1020
RP371C	300	91	500	409	4.4945
HP146H	150	90	100	10	.1111
RP415D	150	67	100	33	.4925
HP142H	100	65	50	-15	-.2308
RP253C	100	62	50	-12	-.1935
RP329C	<100	60	5	-55	-.9167
RP453I	<100	47	5	-42	-.8936
HP262D	<100	44	50	6	.1364
RP363D	<100	35	100	65	1.8571
RP377L	<100	35	20	-15	-.4286
RP344F	<100	32	100	68	2.1250
RP331F	<100	30	7	-23	-.7667
RP374C	<100	29	10	-19	-.6552
HP144H	<100	23	20	-3	-.1304
RP309L	<100	21	--	--	--
RP254C	<100	20	20	0	.0
RP341C	<100	20	<5	--	--
RP431A	<100	19	20	1	.0526
RP365L	<100	19	5	-14	-.7368
RP453J	<100	19	5	-14	-.7368
HP123H	<100	18	30	12	.6667
HP261D	<100	18	10	-8	-.4444
RP453M	<100	18	<5	--	--
RP450C	<100	16	20	4	.2500
HP400G	<100	16	<5	--	--
RP375A	<100	15	--	--	--
HP400C	<100	14	10	-4	-.2857
RP334C	<100	14	--	--	--
HP141C	<100	13	10	-3	-.2308
RP251C	<100	13	10	-3	-.2308
RP377C	<100	13	10	-3	-.2308
RP362C	<100	12	50	38	3.1667
RP376C	<100	12	5	-7	-.5833
RP449C	<100	12	5	-7	-.5833
HP104C	<100	11	20	9	.8182
RP404C	<100	10	10	0	.0
HP111C	<100	10	5	-5	-.5000
HP148C	<100	10	5	-5	-.5000

Table 9. Continued.

Sample	(1)	(2)	(3)	(4)	(5)
HP128L	<100	9	50	41	4.5556
RP252C	<100	9	10	1	.1111
RP255C	<100	9	10	1	.1111
HP112C	<100	9	5	-4	-.4444
RP404G	<100	9	<15	--	--
RP335C	<100	9	--	--	--
RP342C	<100	9	--	--	--
RP351G	<100	9	--	--	--
RP379A	<100	9	--	--	--
RP345L	150	8	30	22	2.7500
RP454H	<100	8	20	12	1.5000
RP366C	<100	8	7	-1	-.1250
RP442G	<100	8	<5	--	--
HP147H	<100	8	--	--	--
HP114C	<100	7	10	3	.4286
RP354C	<100	7	10	3	.4286
AF404C	<100	7	<5	--	--
RP361G	<100	7	<5	--	--
RP413C	<100	7	<5	--	--
RP147C	<100	7	--	--	--
RP350G	<100	7	--	--	--
RP353C	<100	7	--	--	--
RP358C	<100	7	--	--	--
RP378A	<100	7	--	--	--
RP310C	<100	6	20	14	2.3333
RP373C	<100	6	5	-1	-.1667
RP401G	<100	6	<5	--	--
RP413G	<100	6	<5	--	--
HP109C	<100	6	--	--	--
RP347G	<100	6	--	--	--
RP380C	<100	6	--	--	--
HP149C	<100	5	10	5	1.0000
HP125C	<100	5	5	0	.0
RP453T	<100	5	<5	--	--
RP250C	<100	5	--	--	--
RP351C	<100	5	--	--	--
RP355C	<100	5	--	--	--
RP359C	<100	5	--	--	--
RP365C	<100	5	--	--	--
RP369C	<100	5	--	--	--
HP129F	<100	4	20	16	4.0000
RP364A	<100	4	7	3	.7500
RP400C	<100	4	7	3	.7500
HP105C	<100	4	5	1	.2500
RP343C	<100	4	5	1	.2500
RP448C	<100	4	5	1	.2500
RP411G	<100	4	<5	--	--
RP346A	<100	4	--	--	--
RP411C	150	3	50	47	15.6667
RP370C	<100	3	20	17	5.6667

Table 9. Continued

Sample	(1)	(2)	(3)	(4)	(5)
HP107C	<100	3	10	7	2.3333
HP118F	<100	3	10	7	2.3333
HP135F	<100	3	10	7	2.3333
HP151C	<100	3	10	7	2.3333
HP116C	<100	3	7	4	1.3333
HP122C	<100	3	5	2	.6667
HP126C	<100	3	5	2	.6667
HP150C	<100	3	5	2	.6667
RP361C	<100	3	5	2	.6667
RP406C	<100	3	5	2	.6667
RP443C	<100	3	<5	--	--
RP348C	<100	3	--	--	--
RP352C	<100	3	--	--	--
HP127C	<100	2	10	8	4.0000
RP322C	<100	2	7	5	2.5000
RP410C	<100	2	5	3	1.5000
AF401C	<100	2	<5	--	--
RP419D	<100	<2	50	--	--
HP134F	<100	<2	20	--	--
HP138C	<100	<2	20	--	--
HP264D	<100	<2	20	--	--
RP315C	<100	<2	20	--	--
RP354L	<100	<2	20	--	--
RP444C	<100	<2	20	--	--
RP313C	<100	<2	10	--	--
RP319C	<100	<2	10	--	--
HP130C	<100	<2	5	--	--
RP311C	<100	<2	5	--	--
RP316C	<100	<2	5	--	--
RP318C	<100	<2	5	--	--
RP326C	<100	<2	5	--	--
AF400C	<100	<2	<5	--	--
RP314C	<100	<2	<5	--	--
AF101C	<100	<2	--	--	--
AF102F	<100	<2	--	--	--
HP113C	<100	<2	--	--	--
HP119F	<100	<2	--	--	--
HP132C	<100	<2	--	--	--
HP145C	<100	<2	--	--	--
RP300F	<100	<2	--	--	--
RP302C	<100	<2	--	--	--
RP303F	<100	<2	--	--	--
RP305C	<100	<2	--	--	--
RP306C	<100	<2	--	--	--
RP308A	<100	<2	--	--	--
RP325C	<100	<2	--	--	--

(1) L. Bradley and M. Malcolm, analysts; (2) P.H. Briggs, analyst.
--, Not analysed.

Table 10. Mercury by cold vapor cell (ppm).

Sample	(1) Hg by cold vapor cell	(2) Hg by this method	(3) This method minus cold vapor cell	(4) Ratio of (3) to (1)
1K95E B	9.90	10.0	.10	.0101
1K95CHAB	7.70	7.0	-.70	-.0909
1K95G B	6.00	3.0	-3.00	-.5000
2K90HA G	4.00	5.0	1.00	.2500
1K95R B	2.80	3.0	.20	.0714
1K95B B	.75	1.0	.25	.3333
1S83D K	.55	1.0	.45	.8182
1S29F K	.50	<.3	--	--
1K95P B	.24	.5	.26	1.0833
1K95L B	.10	<.3	--	--
2K90IA G	.05	3.0	2.95	59.0000

(1) V. Merritt and J.G. Crock, analysts.
--, Not analysed.

Table 11. Bismuth by ICAP-AES (ppm).

Sample	(1) Bi by ICAP-AES	(2) Bi by this method	(3) This method minus ICAP-AES	(4) Ratio of (3) to (1)
1K95CHAB	1,200	300.0	-900	-.7500
1K95L B	340	100.0	-240	-.7059
1K95B B	280	<.5	--	--
2K90D1BJ	240	100.0	-140	-.5833
1K95G B	180	50.0	-130	-.7222
1K55 B	160	2.0	-158	-.9875
2K90HA G	100	70.0	-30	-.3000
1K 6 B	100	<.5	--	--
2B25B A	90	50.0	-40	-.4444
1K95E B	80	30.0	-50	-.6250
1K95R B	30	7.0	-23	-.7667
1K30A B	30	<.5	--	--
0G12A2 J	20	50.0	30	1.5000
2B25A A	20	50.0	30	1.5000
1S83C J	20	<.5	--	--
2K26A M	<20	50.0	--	--
2K26C M	<20	50.0	--	--
0G12A1 J	<20	20.0	--	--
1K95P B	<20	5.0	--	--
2K90IA G	<20	5.0	--	--
2K90FG J	<20	3.0	--	--
2K27 M	<20	2.0	--	--
1S28C J	<20	1.0	--	--
2B 7C A	<20	1.0	--	--
2K28A M	<20	1.0	--	--
1S28E J	<20	.5	--	--
1K28B B	<20	<.5	--	--
1K40 B	<20	<.5	--	--
1K89G A	<20	<.5	--	--
1S29F K	<20	<.5	--	--
1S83D K	<20	<.5	--	--
2B10C A	<20	<.5	--	--
2B11I A	<20	<.5	--	--
2B18A M	<20	<.5	--	--
2B21A A	<20	<.5	--	--
2B23A A	<20	<.5	--	--
2K 8 M	<20	<.5	--	--
2K 9B C	<20	<.5	--	--
2K11A M	<20	<.5	--	--
2K11B M	<20	<.5	--	--
2K12B M	<20	<.5	--	--
2K13A M	<20	<.5	--	--
2K13A2 M	<20	<.5	--	--
2K15A M	<20	<.5	--	--
2K26D M	<20	<.5	--	--
2K29 M	<20	<.5	--	--
2K30 M	<20	<.5	--	--

(1) P.H. Briggs, analyst.
--, Not analysed.

Table 12. Bismuth by 6-step and A-Z (ppm).

Sample	(1) Bi by 6-step	(2) Bi by A-Z	(3) Bi by this method	(4) This method minus A-Z	(5) Ratio of (4) to (2)
RP453I	150	140	20.0	-120.0	-.8571
RP450C	150	120	100.0	-20.0	-.1667
HP144H	100	100	50.0	-50.0	-.5000
RP453H	70	82	10.0	-72.0	-.8780
RP455D	50	41	10.0	-31.0	-.7561
RP431G	30	32	20.0	-12.0	-.3750
RP455I	20	22	10.0	-12.0	-.5455
HP142H	20	22	5.0	-17.0	-.7727
RP419D	15	10	5.0	-5.0	-.5000
RP415D	<10	8	3.0	-5.0	-.6250
RP356G	<10	5	10.0	5.0	1.0000
RP331C	<10	5	2.0	-3.0	-.6000
RP365L	<10	5	<.5	--	--
RP310C	<10	3	5.0	2.0	.6667
RP454H	<10	3	5.0	2.0	.6667
RP328H	<10	3	2.0	-1.0	-.3333
RP366C	<10	3	2.0	-1.0	-.3333
RP313C	<10	3	1.0	-2.0	-.6667
RP453J	<10	3	1.0	-2.0	-.6667
HP400G	<10	3	.5	-2.5	-.8333
RP431A	<10	2	5.0	3.0	1.5000
RP413G	<10	2	.5	-1.5	-.7500
RP346A	<10	2	--	--	--
RP348C	<10	2	--	--	--
RP351C	<10	2	--	--	--
HP123H	<10	<2	2.0	--	--
HP127C	<10	<2	1.0	--	--
HP141C	<10	<2	1.0	--	--
RP311C	<10	<2	1.0	--	--
RP344F	<10	<2	1.0	--	--
RP371C	<10	<2	1.0	--	--
RP371H	<10	<2	1.0	--	--
HP122C	<10	<2	.5	--	--
HP129F	<10	<2	.5	--	--
HP260D	<10	<2	.5	--	--
RP252C	<10	<2	.5	--	--
RP254C	<10	<2	.5	--	--
RP255C	<10	<2	.5	--	--
RP316C	<10	<2	.5	--	--
RP328L	<10	<2	.5	--	--
RP329C	<10	<2	.5	--	--
RP343C	<10	<2	.5	--	--
RP361G	<10	<2	.5	--	--
RP373C	<10	<2	.5	--	--
RP406C	<10	<2	.5	--	--
RP448H	<10	<2	.5	--	--
RP449C	<10	<2	.5	--	--
RP453M	<10	<2	.5	--	--
RP413C	<10	<2	<10.0	--	--
AF400C	<10	<2	<.5	--	--

Table 12. Continued.

Sample	(1)	(2)	(3)	(4)	(5)
AF401C	<10	<2	<.5	--	--
AF404C	<10	<2	<.5	--	--
HP104C	<10	<2	<.5	--	--
HP105C	<10	<2	<.5	--	--
HP107C	<10	<2	<.5	--	--
HP108H	<10	<2	<.5	--	--
HP111C	<10	<2	<.5	--	--
HP112C	<10	<2	<.5	--	--
HP114C	<10	<2	<.5	--	--
HP116C	<10	<2	<.5	--	--
HP118F	<10	<2	<.5	--	--
HP125C	<10	<2	<.5	--	--
HP126C	<10	<2	<.5	--	--
HP128L	<10	<2	<.5	--	--
HP130C	<10	<2	<.5	--	--
HP134F	<10	<2	<.5	--	--
HP135F	<10	<2	<.5	--	--
HP138C	<10	<2	<.5	--	--
HP146H	<10	<2	<.5	--	--
HP148C	<10	<2	<.5	--	--
HP149C	<10	<2	<.5	--	--
HP150C	<10	<2	<.5	--	--
HP151C	<10	<2	<.5	--	--
HP261D	<10	<2	<.5	--	--
HP262D	<10	<2	<.5	--	--
HP264D	<10	<2	<.5	--	--
HP400C	<10	<2	<.5	--	--
RP251C	<10	<2	<.5	--	--
RP253C	<10	<2	<.5	--	--
RP314C	<10	<2	<.5	--	--
RP315C	<10	<2	<.5	--	--
RP318C	<10	<2	<.5	--	--
RP319C	<10	<2	<.5	--	--
RP322C	<10	<2	<.5	--	--
RP326C	<10	<2	<.5	--	--
RP331F	<10	<2	<.5	--	--
RP341C	<10	<2	<.5	--	--
RP345L	<10	<2	<.5	--	--
RP354C	<10	<2	<.5	--	--
RP354L	<10	<2	<.5	--	--
RP361C	<10	<2	<.5	--	--
RP362C	<10	<2	<.5	--	--
RP363D	<10	<2	<.5	--	--
RP364A	<10	<2	<.5	--	--
RP370C	<10	<2	<.5	--	--
RP374C	<10	<2	<.5	--	--
RP376C	<10	<2	<.5	--	--
RP377C	<10	<2	<.5	--	--
RP377L	<10	<2	<.5	--	--
RP400C	<10	<2	<.5	--	--

Table 12. Continued.

Sample	(1)	(2)	(3)	(4)	(5)
RP401G	<10	<2	<.5	--	--
RP404C	<10	<2	<.5	--	--
RP404G	<10	<2	<.5	--	--
RP410C	<10	<2	<.5	--	--
RP411C	<10	<2	<.5	--	--
RP411G	<10	<2	<.5	--	--
RP442G	<10	<2	<.5	--	--
RP443C	<10	<2	<.5	--	--
RP444C	<10	<2	<.5	--	--
RP448C	<10	<2	<.5	--	--
RP453T	<10	<2	<.5	--	--
AF101C	<10	<2	--	--	--
AF102F	<10	<2	--	--	--
HP109C	<10	<2	--	--	--
HP113C	<10	<2	--	--	--
HP119F	<10	<2	--	--	--
HP132C	<10	<2	--	--	--
HP145C	<10	<2	--	--	--
HP147H	<10	<2	--	--	--
RP147C	<10	<2	--	--	--
RP250C	<10	<2	--	--	--
RP300F	<10	<2	--	--	--
RP302C	<10	<2	--	--	--
RP303F	<10	<2	--	--	--
RP305C	<10	<2	--	--	--
RP306C	<10	<2	--	--	--
RP308A	<10	<2	--	--	--
RP309L	<10	<2	--	--	--
RP325C	<10	<2	--	--	--
RP334C	<10	<2	--	--	--
RP335C	<10	<2	--	--	--
RP342C	<10	<2	--	--	--
RP347G	<10	<2	--	--	--
RP350G	<10	<2	--	--	--
RP351G	<10	<2	--	--	--
RP352C	<10	<2	--	--	--
RP353C	<10	<2	--	--	--
RP355C	<10	<2	--	--	--
RP358C	<10	<2	--	--	--
RP359C	<10	<2	--	--	--
RP365C	<10	<2	--	--	--
RP369C	<10	<2	--	--	--
RP375A	<10	<2	--	--	--
RP378A	<10	<2	--	--	--
RP379A	<10	<2	--	--	--
RP380C	<10	<2	--	--	--

(1) L. Bradley and M. Malcolm, analysts; (2) P.H. Briggs, analyst.
--, Not analysed.

Table 13. Gallium by ICAP-AES (ppm).

Sample	(1) Ga by ICAP-AES	(2) Ga by this method	(3) This method minus ICAP-AES	(4) Ratio of (3) to (1)
2K15A M	150	.5	-149.5	-.9967
2B18A M	21	.5	-20.5	-.9762
2K27 M	12	.5	-11.5	-.9583
2K11A M	11	5.0	-6.0	-.5455
2K90IA G	11	<.5	--	--
2K26C M	10	30.0	20.0	2.0000
2K26D M	10	<.5	--	--
2K13A M	9	5.0	-4.0	-.4444
1S83C J	8	5.0	-3.0	-.3750
1S83D K	8	.5	-7.5	-.9375
1S28C J	<8	30.0	--	--
0G12A1 J	<8	7.0	--	--
2K 8 M	<8	2.0	--	--
2K28A M	<8	2.0	--	--
2K29 M	<8	2.0	--	--
0G12A2 J	<8	1.0	--	--
2K11B M	<8	1.0	--	--
2K13A2 M	<8	1.0	--	--
2K90D1BJ	<8	1.0	--	--
2K90FG J	<8	1.0	--	--
2K12B M	<8	.5	--	--
2K30 M	<8	.5	--	--
2K90HA G	<8	.5	--	--
1S28E J	<8	<.5	--	--
1S29F K	<8	<.5	--	--

(1) P.H. Briggs, analyst.
--, Not analysed.

Table 14. Summary of all results by present method (ppm).

Sample	Location	Ag	As	Au	Bi	Ga	Hg
2B25A A	10	500.0	1,000	.2	50.0	2.0	30.0
2B25B A	10	>1,000.0	700	.2	50.0	2.0	20.0
2B23A A	13	200.0	50	1.5	<.5	1.0	10.0
2B11I A	16	500.0	30	.3	<.5	.5	5.0
2B18A M	17	20.0	5	<.2	<.5	.5	.5
2B 7C A	23	50.0	20	<.2	1.0	2.0	3.0
2B10C A	24	20.0	10	.5	<.5	.5	3.0
1K89G A	27	30.0	20	.5	<.5	<.5	1.0
2K11A M	30	50.0	700	5.0	<.5	5.0	3.0
2K11B M	30	30.0	5	<.2	<.5	1.0	3.0
2K13A M	31	15.0	200	10.0	<.5	5.0	10.0
2K13A2 M	31	100.0	100	5.0	<.5	1.0	10.0
2K12B M	32	50.0	200	10.0	<.5	.5	10.0
2K90D1BJ	33	300.0	100	2.0	100.0	1.0	5.0
2K90FG J	33	30.0	500	.2	3.0	1.0	5.0
2K90HA G	33	500.0	1,000	2.0	70.0	.5	5.0
2K90IA G	33	200.0	700	.2	5.0	<.5	3.0
2B21A A	34	500.0	15	.2	<.5	.5	1.0
2K30 M	39	20.0	500	.5	<.5	.5	5.0
2K29 M	40	20.0	10	<.2	<.5	2.0	<.3
2K28A M	41	1,000.0	500	<.2	1.0	2.0	20.0
2K26A M	42	500.0	20	<.2	50.0	--	1.0
2K26C M	42	100.0	20	.3	50.0	30.0	1.0
2K26D M	42	200.0	50	<.2	<.5	<.5	3.0
2K27 M	43	100.0	10	.2	2.0	.5	1.0
1S29F K	48	1,000.0	100	<.2	<.5	<.5	<.3
1S28C J	55	30.0	50	<.2	1.0	30.0	.3
1S28E J	55	100.0	100	<.2	.5	<.5	1.0
1K55 B	60	500.0	10	.2	2.0	1.0	<.3
0G12A1 J	61	50.0	50	5.0	20.0	7.0	1.0
0G12A2 J	61	1,000.0	50	10.0	50.0	1.0	3.0
1S83C J	62	30.0	200	2.0	<.5	5.0	<.3
1S83D K	62	20.0	10	<.2	<.5	.5	1.0
2K15A M	64	30.0	15	.5	<.5	.5	30.0
2K 8 M	65	200.0	200	.4	<.5	2.0	40.0
2K 9B C	66	50.0	1,000	<.2	<.5	1.0	50.0
1K40 B	67	200.0	5	3.0	<.5	2.0	.3
1K30A B	88	10.0	10	<.2	<.5	1.0	.3
1K28B B	89	50.0	20	<.2	<.5	.5	.3
1K 6 B	113	500.0	1,000	<.2	<.5	2.0	5.0
1K95B B	116	--	5	<.2	<.5	2.0	1.0
1K95CHAB	116	50.0	5	<.2	300.0	20.0	7.0
1K95E B	116	20.0	30	<.2	30.0	200.0	10.0
1K95G B	116	50.0	10	<.2	50.0	20.0	3.0
1K95L B	116	30.0	15	<.2	100.0	5.0	<.3
1K95P B	116	5.0	20	<.2	5.0	5.0	.5
1K95R B	116	10.0	20	<.2	7.0	10.0	3.0
HP260D	241	100.0	100	.7	.5	200.0	50.0
HP261D	241	2.0	750	2.0	<.5	<.5	<.3
HP262D	241	200.0	150	.5	<.5	3.0	1.0

Table 14. Continued.

Sample	In	Sb	Sn	Te	Tl
2B25A A	5.0	>1,000	<1	300	.3
2B25B A	30.0	>1,000	5	500	<.3
2B23A A	1.0	500	<1	7	<.3
2B11I A	10.0	1,000	2	50	<.3
2B18A M	100.0	10	10	<3	<.3
2B 7C A	1.0	50	<1	30	<.3
2B10C A	50.0	5	5	<3	<.3
1K89G A	100.0	20	20	50	<.3
2K11A M	10.0	50	<1	50	5.0
2K11B M	1.0	100	<1	30	<.3
2K13A M	20.0	50	<1	50	30.0
2K13A2 M	3.0	100	<1	100	.5
2K12B M	1.0	50	<1	50	<.3
2K90D1BJ	2.0	100	--	30	>100.0
2K90FG J	2.0	500	3	150	<.3
2K90HA G	100.0	1,000	10	100	<.3
2K90IA G	100.0	1,000	10	50	<.3
2B21A A	100.0	500	10	10	<.3
2K30 M	2.0	50	<1	<3	<.3
2K29 M	.5	50	<1	<3	5.0
2K28A M	7.0	>1,000	1	5	<.3
2K26A M	--	200	<1	50	<.3
2K26C M	50.0	100	<1	10	<.3
2K26D M	1.0	500	<1	5	<.3
2K27 M	1.0	50	<1	<3	<.3
1S29F K	.5	100	<1	<3	<.3
1S28C J	7.0	300	<1	<3	<.3
1S28E J	<.5	500	<1	<3	<.3
1K55 B	2.0	100	<1	<3	<.3
0G12A1 J	3.0	500	<1	200	<.3
0G12A2 J	1.0	500	<1	>1,000	.3
1S83C J	2.0	5	<1	3	<.3
1S83D K	.5	10	<1	<3	<.3
2K15A M	1.0	<5	<1	200	<.3
2K 8 M	.5	>1,000	<1	100	<.3
2K 9B C	1.0	>1,000	5	200	.3
1K40 B	<.5	<5	<1	<3	<.3
1K30A B	.5	50	2	10	.3
1K28B B	<.5	5	1	10	<.3
1K 6 B	<.5	>1,000	50	500	.3
1K95B B	2.0	5	--	30	.3
1K95CHAB	100.0	10	10	100	<.3
1K95E B	200.0	50	500	200	<.3
1K95G B	100.0	10	2	50	<.3
1K95L B	70.0	30	30	200	<.3
1K95P B	10.0	5	5	10	<.3
1K95R B	50.0	20	5	70	<.3
HP260D	100.0	500	1	5	.5
HP261D	1.0	10	1	<3	<.3
HP262D	2.0	50	<1	<3	7.0

Table 14. Continued.

Sample	Location	Ag	As	Au	Bi	Ga	Hg
HP264D	241	20.0	50	.3	<.5	5.0	1.0
AF400C	255	<.1	<5	<.2	<.5	1.0	.3
AF401C	256	<.1	<5	<.2	<.5	.5	.3
AF404C	261	.1	<5	<.2	<.5	10.0	<.3
HP150C	323	1.0	200	<.1	<.5	7.0	<.3
HP149C	325	2.0	100	<.1	<.5	5.0	<.3
HP127C	340	1.0	75	<.1	1.0	2.0	<.3
HP126C	341	1.0	20	<.1	<.5	7.0	.3
HP125C	342	5.0	100	<.1	<.5	5.0	<.3
HP118F	347	2.0	150	<.1	<.5	5.0	<.3
HP116C	349	2.0	100	<.1	<.5	5.0	<.3
HP114C	350	1.0	300	<.1	<.5	5.0	<.3
HP112C	352	.3	200	<.1	<.5	5.0	<.3
HP111C	353	1.0	100	<.1	<.5	5.0	<.3
HP108H	357	1.0	>1,000	<.1	<.5	7.0	2.0
HP107C	362	.5	100	<.1	<.5	5.0	<.3
HP105C	372	2.0	100	<.1	<.5	5.0	<.3
HP104C	373	20.0	100	<.1	<.5	5.0	<.3
HP123H	382	50.0	200	<.1	2.0	7.0	.3
HP128L	391	.5	500	<.1	<.5	5.0	--
HP129F	394	10.0	100	<.1	.5	5.0	.3
HP130C	395	.2	50	<.1	<.5	5.0	<.3
HP134F	399	3.0	200	.2	<.5	10.0	<.3
HP135F	400	10.0	100	<.1	<.5	7.0	<.3
HP138C	403	5.0	75	<.1	<.5	5.0	<.3
HP146H	406	50.0	1,000	.2	<.5	2.0	.5
HP148C	408	.7	200	<.1	<.5	5.0	<.3
HP144H	425	50.0	10	<.1	50.0	2.0	<.3
HP141C	430	3.0	100	<.1	1.0	5.0	<.3
HP142H	432	50.0	500	.5	5.0	5.0	<.3
RP453T	590	<.1	<5	<.2	<.5	5.0	<.3
RP453H	592	50.0	30	<.2	10.0	1.0	.3
RP453I	592	50.0	10	<.2	20.0	1.0	<.3
RP453J	592	5.0	<5	<.2	1.0	2.0	.3
RP453M	592	.3	<5	<.2	.5	5.0	<.3
RP419D	595	20.0	30	<.2	5.0	7.0	.5
RP415D	604	100.0	30	7.0	3.0	1.0	.5
RP413C	606	.1	<5	<.2	<10.0	2.0	<.3
RP413G	606	.2	5	<.2	.5	5.0	<.3
RP374C	614	30.0	20	<.1	<.5	5.0	<.3
RP361C	615	2.0	50	<.1	<.5	5.0	<.3
RP361G	615	.5	50	<.1	.5	7.0	<.3
RP356G	620	10.0	50	<.1	10.0	20.0	<.3
RP344F	628	50.0	200	.1	1.0	5.0	<.3
RP343C	629	.2	10	<.1	.5	3.0	<.3
RP341C	638	.5	75	<.1	<.5	10.0	<.3
RP376C	640	2.0	50	.5	<.5	2.0	<.3
RP371C	643	50.0	100	<.1	1.0	5.0	<.3
RP371H	643	200.0	200	<.1	1.0	3.0	.5
RP326C	651	.2	50	<.1	<.5	3.0	<.3

Table 14. Continued.

Sample	In	Sb	Sn	Te	Tl
HP264D	5.0	20	<1	<3	<.3
AF400C	<.5	<5	<1	<3	<.3
AF401C	.5	<5	<1	<3	<.3
AF404C	2.0	<5	<1	<3	.3
HP150C	1.0	5	1	7	1.0
HP149C	1.0	10	1	5	1.0
HP127C	1.0	10	<1	<3	1.0
HP126C	2.0	5	1	<3	3.0
HP125C	.5	5	1	<3	50.0
HP118F	.5	10	<1	<3	.5
HP116C	1.0	7	<1	<3	5.0
HP114C	2.0	10	1	<3	5.0
HP112C	1.0	5	<1	<3	.5
HP111C	1.0	5	<1	<3	5.0
HP108H	1.0	1,000	1	<3	100.0
HP107C	1.0	10	1	<3	5.0
HP105C	.5	5	1	<3	5.0
HP104C	1.0	20	<1	5	7.0
HP123H	2.0	30	1	50	5.0
HP128L	<.5	50	<1	<3	<.3
HP129F	<.5	20	<1	<3	.5
HP130C	1.0	5	<1	<3	.5
HP134F	<.5	20	<1	<3	1.0
HP135F	1.0	10	1	<3	5.0
HP138C	1.0	20	<1	<3	5.0
HP146H	1.0	100	<1	5	5.0
HP148C	1.0	5	1	<3	2.0
HP144H	15.0	20	<1	30	<.3
HP141C	1.0	10	<1	5	3.0
HP142H	2.0	50	<1	50	1.0
RP453T	1.0	<5	<1	<3	<.3
RP453H	7.0	100	<1	5	.3
RP453I	5.0	5	<1	30	<.3
RP453J	100.0	5	2	<3	3.0
RP453M	5.0	<5	1	<3	.5
RP419D	2.0	50	1	5	.3
RP415D	10.0	100	<1	100	1.0
RP413C	2.0	<5	<1	<3	.3
RP413G	1.0	<5	<1	15	<.3
RP374C	1.0	10	<1	<3	.5
RP361C	1.0	5	1	<3	3.0
RP361G	2.0	<5	1	<3	3.0
RP356G	5.0	500	5	7	10.0
RP344F	.5	100	1	150	10.0
RP343C	1.0	5	1	<3	1.0
RP341C	5.0	<5	1	<3	3.0
RP376C	2.0	5	<1	<3	.5
RP371C	1.0	500	5	50	.3
RP371H	.5	>1,000	1	100	<.3
RP326C	1.0	5	1	<3	.3

Table 14. Continued.

Sample	Location	Ag	As	Au	Bi	Ga	Hg
RP377C	653	5.0	75	<.1	<.5	3.0	<.3
RP377L	653	1.0	150	<.1	<.5	2.0	<.3
RP328H	656	100.0	1,000	<.1	2.0	5.0	<.3
RP328L	656	.7	200	<.1	.5	.5	<.3
RP329C	657	2.0	10	<.1	.5	5.0	<.3
RP331C	661	10.0	100	<.1	2.0	5.0	<.3
RP331F	661	5.0	200	<.1	<.5	5.0	<.3
RP406C	664	.2	50	<.2	.5	2.0	<.3
RP410C	665	.2	50	<.2	<.5	3.0	<.3
RP404C	669	5.0	50	<.2	<.5	5.0	<.3
RP404G	669	1.0	50	<.2	<.5	2.0	<.3
RP401G	672	.1	10	<.2	<.5	10.0	<.3
RP400C	673	.1	<5	<.2	<.5	2.0	<.3
RP370C	674	.5	50	<.1	<.5	3.0	<.3
RP354C	705	.2	100	<.1	<.5	2.0	<.3
RP354L	705	2.0	10	<.1	<.5	1.0	<.3
RP431A	711	20.0	100	<.2	5.0	7.0	<.3
RP431G	711	10.0	200	<.2	20.0	10.0	.3
RP455D	712	50.0	100	<.2	10.0	5.0	3.0
RP455I	712	100.0	500	<.2	10.0	75.0	10.0
RP251C	714	1.0	200	<.2	<.5	2.0	<.3
RP252C	714	.5	100	<.2	.5	3.0	<.3
RP253C	714	100.0	300	.3	<.5	2.0	.3
RP254C	714	7.0	300	.3	.5	7.0	.5
RP411C	717	7.0	5	<.2	<.5	5.0	<.3
RP411G	717	.1	10	<.2	<.5	5.0	<.3
RP345L	718	.3	300	<.1	<.5	2.0	<.3
RP255C	723	2.0	50	<.2	.5	10.0	<.3
RP310C	740	.5	200	<.1	5.0	2.0	<.3
RP454H	753	5.0	<5	<.2	5.0	3.0	.5
RP444C	761	.2	<5	<.2	<.5	1.0	<.3
RP443C	762	.2	7	--	<.5	3.0	<.3
RP442G	763	.1	5	<.2	<.5	7.0	<.3
RP448C	768	1.0	10	<.2	<.5	5.0	<.3
RP448H	768	50.0	75	<.2	.5	10.0	.5
RP449C	771	2.0	20	<.2	.5	2.0	.3
RP450C	772	30.0	100	<.2	100.0	1.0	.3
RP322C	773	30.0	75	.4	<.5	2.0	<.3
RP319C	776	7.0	150	<.1	<.5	2.0	<.3
RP318C	777	7.0	20	<.1	<.5	5.0	<.3
RP316C	779	2.0	20	.4	.5	5.0	<.3
RP315C	783	50.0	30	.1	<.5	7.0	<.3
RP314C	784	2.0	30	<.1	<.5	3.0	<.3
RP313C	792	10.0	20	<.1	1.0	5.0	<.3
RP311C	797	1.0	100	<.1	1.0	5.0	<.3
RP363D	803	200.0	200	.2	<.5	10.0	<.3
RP362C	804	200.0	200	.2	<.5	5.0	<.3
RP364A	805	1.0	20	<.1	<.5	5.0	<.3
RP365L	806	10.0	100	<.1	<.5	.5	<.3
RP366C	807	50.0	50	<.1	2.0	5.0	<.3

Table 14. Continued.

Sample	In	Sb	Sn	Te	Tl
RP377C	1.0	10	<1	30	.3
RP377L	.5	20	<1	<3	<.3
RP328H	1.0	>1,000	5	>1,000	<.3
RP328L	.5	200	<1	>1,000	<.3
RP329C	1.0	5	1	3	.5
RP331C	1.0	500	2	30	1.0
RP331F	1.0	7	1	10	2.0
RP406C	1.0	5	<1	<3	<.3
RP410C	<.5	5	<1	<3	.5
RP404C	<.5	10	<1	10	.5
RP404G	<.5	<15	<1	20	.5
RP401G	<.5	<5	<1	<3	1.0
RP400C	<.5	7	<1	<3	.5
RP370C	2.0	20	<1	<3	.3
RP354C	1.0	10	<1	<3	.3
RP354L	2.0	20	<1	<3	<.3
RP431A	2.0	20	1	10	1.0
RP431G	15.0	100	2	10	7.0
RP455D	.5	200	10	100	.5
RP455I	10.0	>1,000	5	300	<.3
RP251C	1.0	10	--	<3	<.3
RP252C	1.0	10	1	10	.5
RP253C	1.0	50	1	100	3.0
RP254C	2.0	20	<1	50	5.0
RP411C	2.0	50	<1	<3	1.0
RP411G	<.5	<5	1	<3	1.0
RP345L	1.0	30	<1	<3	<.3
RP255C	1.0	10	2	7	7.0
RP310C	2.0	20	1	<3	<.3
RP454H	2.0	20	5	10	1.0
RP444C	<.5	20	<1	<3	<.3
RP443C	<.5	<5	<1	<3	.5
RP442G	<.5	<5	2	<3	.3
RP448C	<.5	5	1	<3	.3
RP448H	<.5	200	1	150	1.0
RP449C	1.0	5	<1	5	.5
RP450C	.5	20	5	10	1.0
RP322C	1.0	7	<1	<3	.3
RP319C	15.0	10	2	<3	--
RP318C	1.0	5	1	<3	1.0
RP316C	1.0	5	1	<3	1.0
RP315C	1.0	20	<1	<3	1.0
RP314C	.5	<5	1	<3	.3
RP313C	2.0	10	2	3	.5
RP311C	1.0	5	1	<3	.5
RP363D	1.0	100	1	<3	.5
RP362C	1.0	50	<1	<3	.5
RP364A	.5	7	1	<3	.3
RP365L	200.0	5	10	<3	<.3
RP366C	1.0	7	1	7	.3

Table 14. Continued.

Sample	Location	Ag	As	Au	Bi	Ga	Hg
RP373C	825	.5	50	<.1	.5	7.0	<.3
RP100C	859	.5	200	<.1	<.5	5.0	<.3
HP122C	882	5.0	200	<.1	.5	5.0	<.3
HP151C	883	.5	150	--	<.5	5.0	<.3
HP400C	909	5.0	100	<.2	<.5	10.0	<.3
HP400G	909	5.0	50	<.2	.5	2.0	.3

Table 14. Continued.

Sample	In	Sb	Sn	Te	Tl
RP373C	2.0	5	1	<3	7.0
RP100C	1.0	10	<1	<3	.3
HP122C	1.0	5	1	7	5.0
HP151C	1.0	10	<1	3	.3
HP400C	1.0	10	<1	3	.5
HP400G	100.0	<5	10	<3	30.0