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GEOLOGY AND TRACE ELEMENT GEOCHEMISTRY
EAST-CENTRAL ALPINE CO., CALIFORNIA

by

FRANK CHRISTOPHER BENEDICT, JR.

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Golden, Colorado

Date: 1/26/84

Signed: Frank Christopher Benedict, Jr.

Approved: Dr. L. Graham Closs
Thesis Advisor

Golden, Colorado

Date: 1/26/84

Dr. Joseph J. Finney
Head
Department of Geology

ABSTRACT

A reconnaissance lithogeochemical exploration survey was performed for precious metal mineralization in east-central Alpine County, California. The Silver Mountain and Monitor-Mogul Mining Districts occur in a Tertiary volcanic sequence where late-stage rhyolite plugs had generated a geothermal system in a thick section of predominantly andesitic rocks. The degree of mineralization correlates with the magnitude of structural preparation and inferred local heat flow gradient. Silver, As, Au, Bi, Sb, Se, Te, and Tl were analyzed using a sulfide selective method. A spatial geochemical zonation is defined that is in general agreement with a proposed hot spring system geochemical/geological model. Specific, near source anomalies are defined by Ag, As, Au, Sb, Se, and Te. Arsenic, Sb, and particularly Se (in the Monitor-Mogul District) show the greatest lateral dispersion away from known mineralization. Thallium anomalies, while spatially associated, are not coincident with the near source anomalies. The use of the sulfide selective extraction technique with its multi-element capabilities and low detection limits was instrumental in the definition of geochemical zoning in this study.

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I would like to acknowledge the Branch of Exploration Geochemistry, United States Geological Survey, and in particular, Maurice A. Chaffee, for the generous financial, logistical, and scientific support received during the field phase of this study. I thank the Geology Department, Colorado School of Mines for providing a research assistantship during my course of study. I would like to acknowledge my thesis committee: Drs. M.A. Chaffee; R.C. Epis; S.S. Goldich; and S.B. Romberger, for their support and advice (and patience) throughout my degree program. Special thanks is due thesis committee chairman Dr. L. Graham Closs for his assistance with the data processing aspects of this study, and his significant contribution toward making this both a memorable and rewarding experience.

INTRODUCTION

Objective

The objective of this research is to evaluate the effectiveness of a selected suite of trace elements as primary indicators of precious metal mineralization. This evaluation will be based on a generalized model of the low to moderate temperature (less than 350° C) epigenetic hydrothermal environment. Key aspects of this investigation will be the spatial distribution of hydrothermal alteration assemblages and associated trace elements (dispersion patterns) within an area known to host ore grade precious metal mineralization. It is suggested that the distribution and magnitude of trace element anomalies will serve as useful guides in exploration and prospect evaluation.

This investigation is approached through a lithogeochemical study of the dispersion characteristics of a selected suite of trace elements (Ag, As, Au, Bi, Sb, Se, Te, and Tl). As documented in the following section, these trace elements are known through work by others to be associated with many epithermal precious metal mineralized systems.

Review of Previous Work

The current trend toward an integrated approach to exploration geology has stimulated much thought in developing conceptual models of ore genesis. The characteristics of these models are used as criteria in delineating favorable exploration targets. Using geological and geochemical data from precious metal deposits and from geothermal areas where material rich in ore metals is currently being deposited, a geological/geochemical model stressing trace element behavior was compiled to serve as a baseline for this study.

Gold and silver are currently being deposited at the surface from dilute thermal waters at the Broadlands, New Zealand geothermal field. Ewers and Keays (1977) have identified a crude vertical metal zoning in hydrothermally altered rock in drill core from this area. Depth-distribution profiles for trace elements in the sulfide fraction mechanically separated from drill core indicate As, Au, Sb, and Tl to be more abundant in the higher levels of the system (figure 1), while Ag, Bi, Se, and Te as well as base metal sulfides predominate in the deeper, higher temperature parts of the system (figures 2 and 3). Electron microprobe studies (Ewers, 1975) suggest As, Au, Sb, and Tl to be incorporated within pyrite, while Ag, Bi, Se, and Te are associated with base metal sulfides, particularly galena.

The Steamboat Springs, Nevada geothermal area has been interpreted (White, 1955, 1967, 1981) to be an active equivalent of hydrothermal

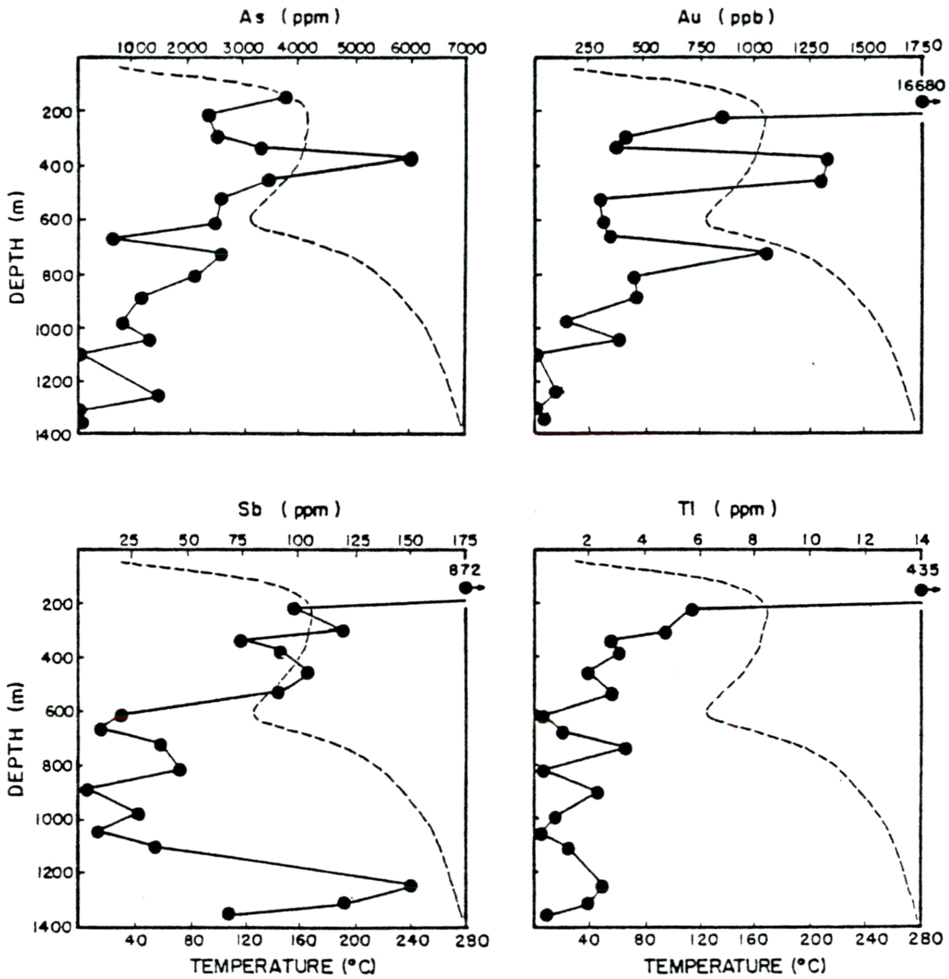


Figure 1) Depth-distribution profiles for As, Au, Sb, and Tl in sulfide fraction from drillhole 16 core, Broadlands, New Zealand. Down-hole temperature is indicated by dashed line. Modified after Ewers and Keays (1977).

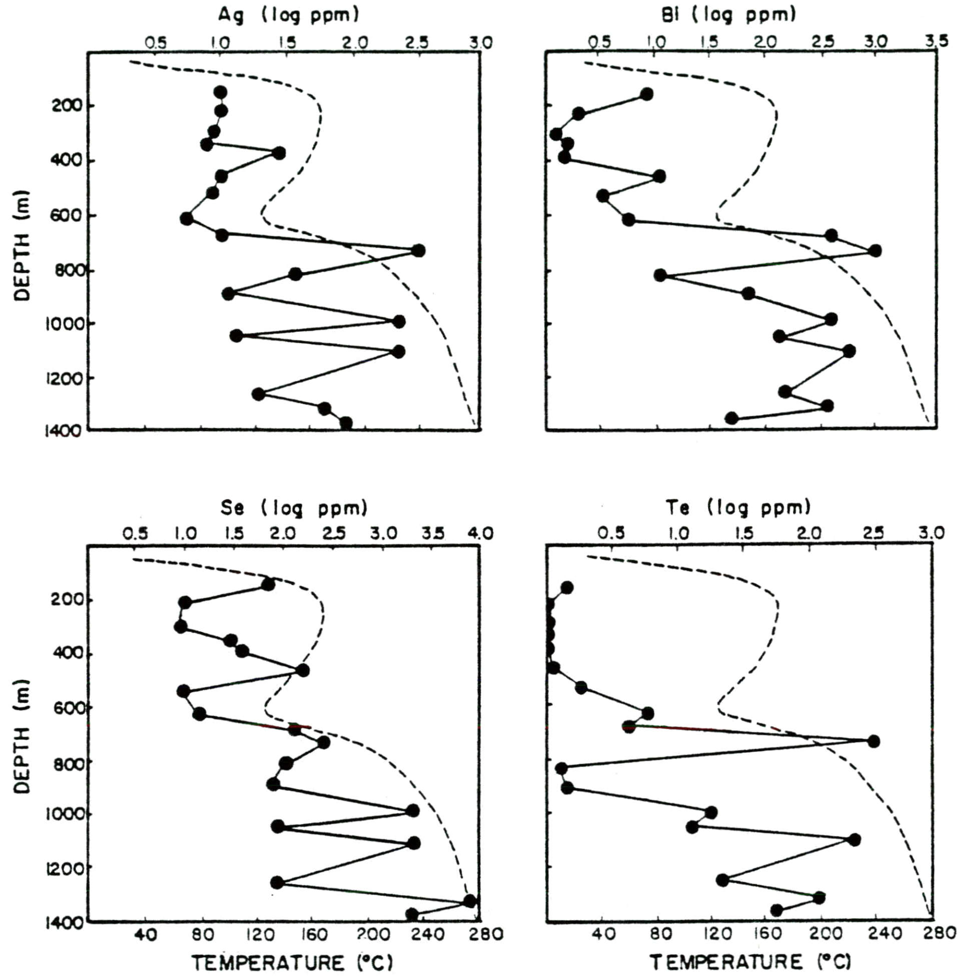


Figure 2) Depth-distribution profiles for Ag, Bi, Se, and Te in sulfide fraction from drillhole 16 core, Broadlands, New Zealand. Down-hole temperature is indicated by dashed line. Modified after Ewers and Keays (1977).

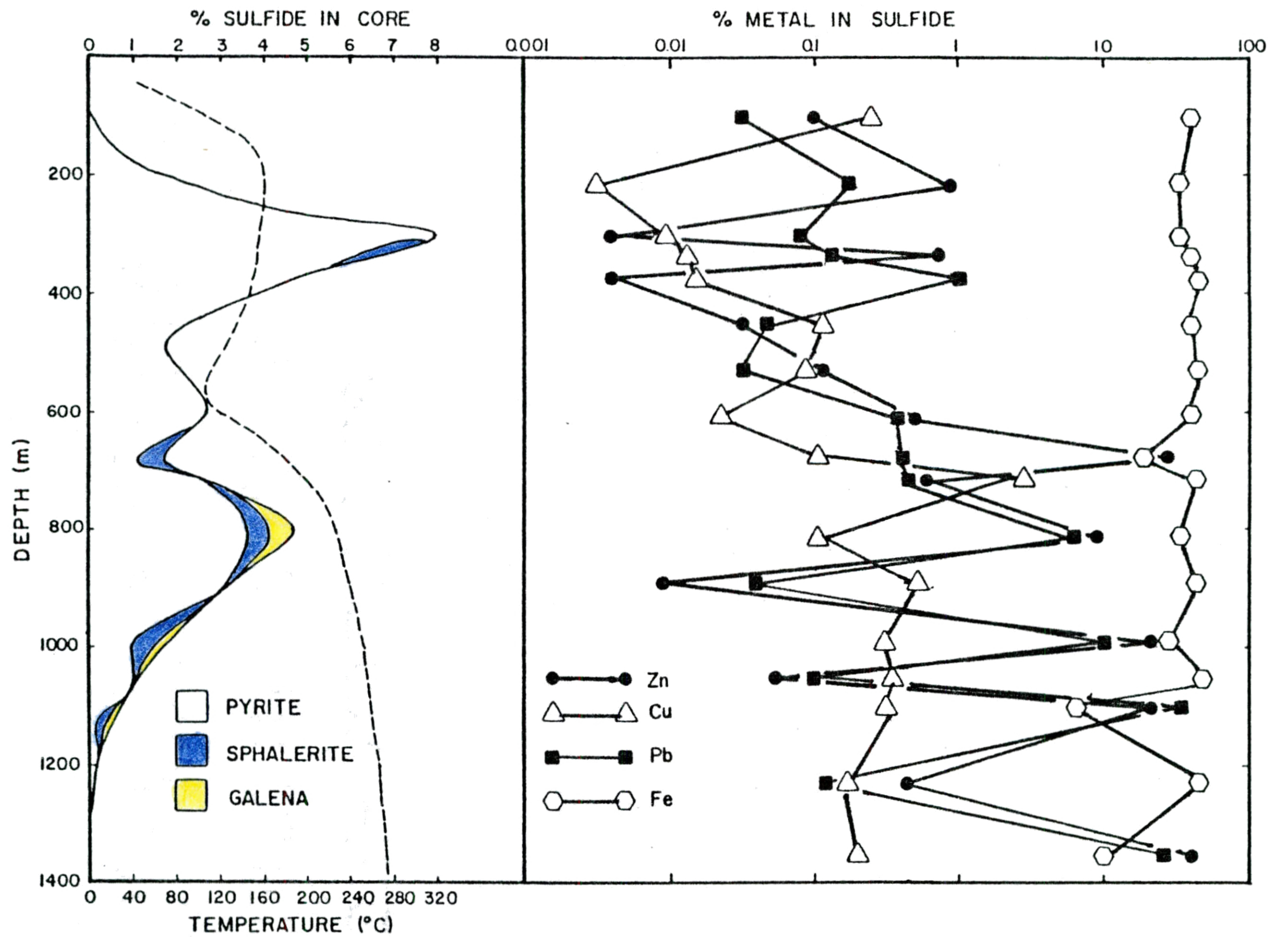


Figure 3) Depth-distribution profiles for sulfides and Cu, Pb, Zn, and Fe content of sulfide fraction from drillhole 16 core, Broadlands, New Zealand. Modified after Ewers and Keays (1977).

systems responsible for the epithermal precious metal deposits throughout the Great Basin of the western United States. Spectrographic data from White (1981) show As, Au, Sb, and Tl being strongly enriched in the upper parts of the system (figure 4) relative to Ag and base metals (figure 5). Note the tendency toward Ag enrichment in the deeper sections of the drill hole.

The results of trace element distribution studies in these active geothermal areas suggest precious metal, base metal, and associated trace element behaviors are process controlled phenomena. The data from geothermal wells, particularly at Broadlands, New Zealand (see figures 1-3) suggest there is a transition from higher temperature silver-basemetal (particularly lead) mineralization to lower temperature (predominantly gold) mineralization. This transition was noted by Ferguson (1929) in an overview of precious metal deposits in the western United States. A dichotomy appeared to exist between gold-dominated precious metal deposits and silver-dominated (commonly accompanied by base metals) precious metal deposits. Nolan (1933) suggested that gold-dominated deposits, such as the Goldfield, Manhattan, and Round Mountain Districts of Nevada, are essentially lower temperature or late stage equivalents of silver-base metal deposits like those found in the Virginia City and Tonopah Districts, Nevada. As summarized in the following section, a similar division has been demonstrated to exist in trace element assemblages from known precious metal deposits.

All, or portions of, the As, Au, Sb, Tl (with or without Hg)

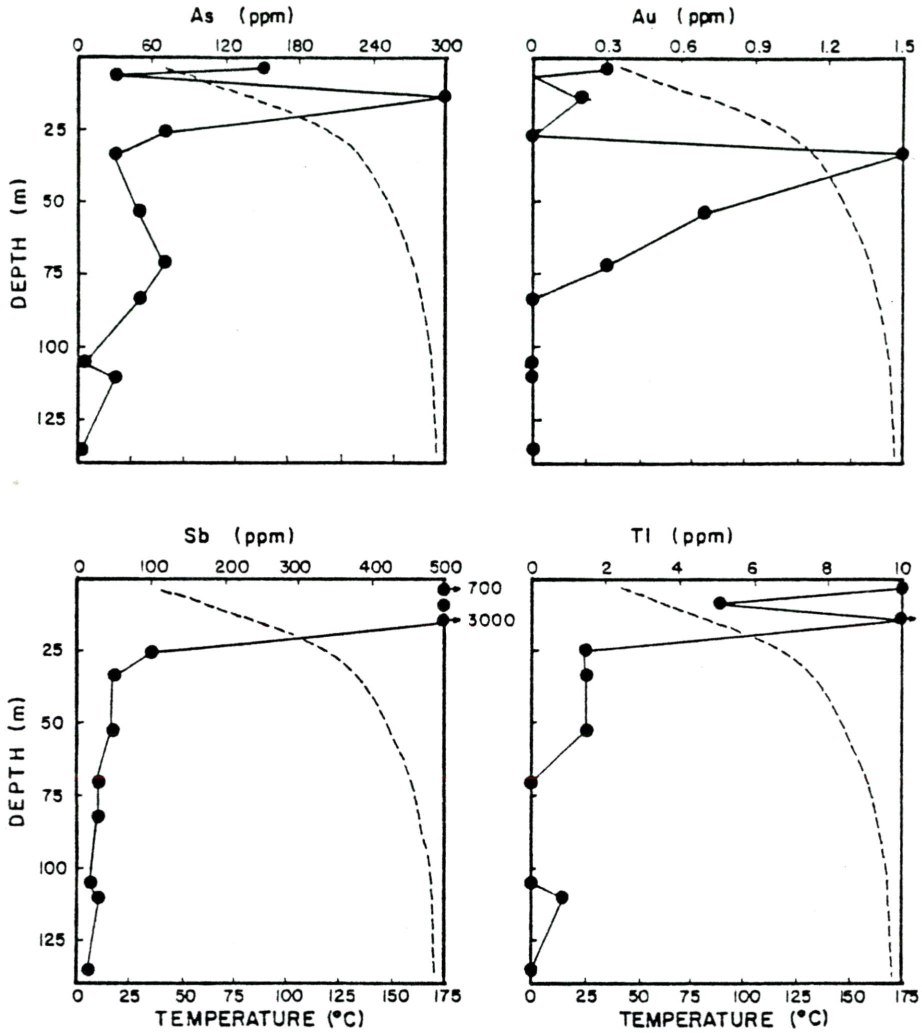


Figure 4) Depth-distribution profiles for As, Au, Sb, and Tl in chemical precipitates from drillhole GS-5 core, Steamboat Springs, Nevada. Down-hole temperature is indicated by dashed line. Data from White (1981).

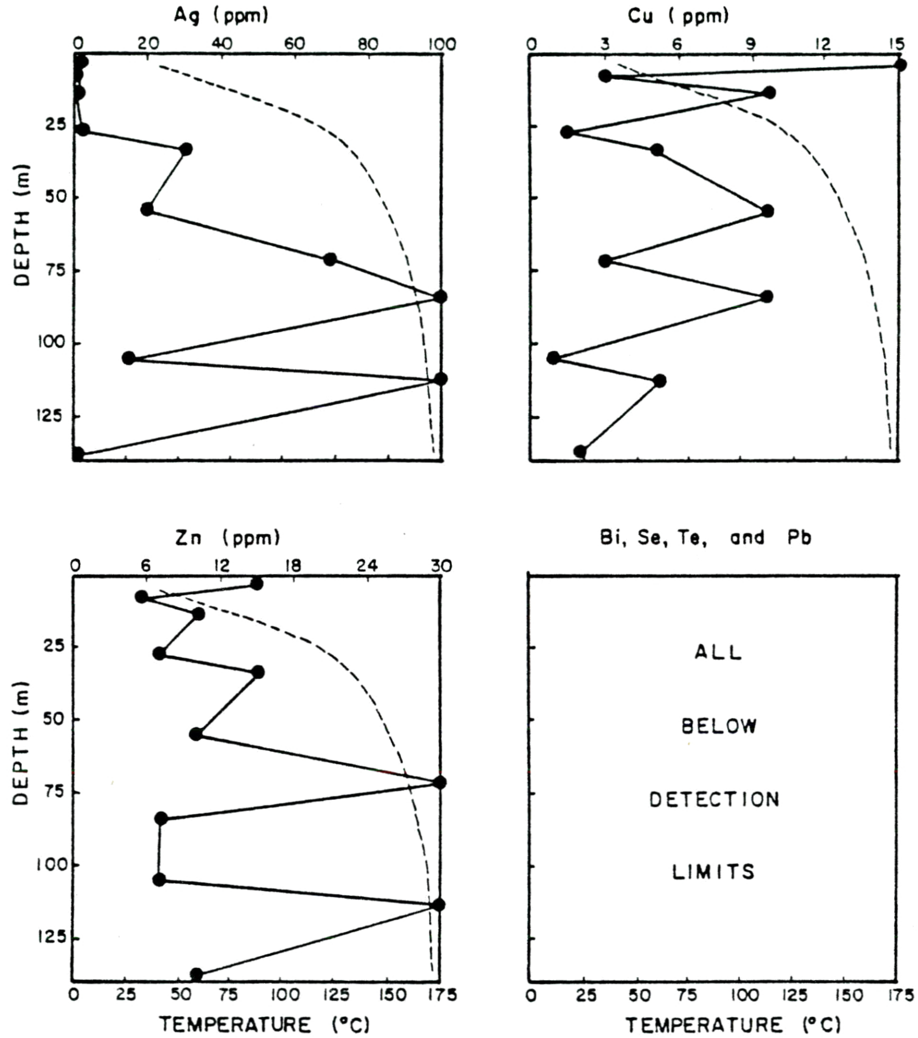


Figure 5) Depth-distribution profiles for Ag, Cu, and Zn in chemical precipitates from drillhole GS-5 core, Steamboat Springs, Nevada. Down-hole temperature is indicated by dashed line. Data from White (1981).

trace element suite are anomalous at the Potosi antimony deposits of Bolivia (Ahlfeld, 1974), at Carlin-type gold deposits (Wells and others, 1969; Harris and Radtke, 1976; Radtke, 1979), and in stages of many other 'epithermal' deposits for which known temperatures of ore deposition were approximately 200° C (for example: Ashley and Albers, 1975; Wrucke and Armbrustmacher, 1975; Ashley and Keith, 1976).

The Ag, Bi, Se, Te, (sometimes accompanied by Sb) trace element assemblage is more commonly associated with systems containing base metals where typical temperatures of ore deposition exceed (often considerably) 200° C. Examples include the Darwin Pb-Zn-Ag deposit, California (Czamanske and Hall, 1975); polymetallic deposits in the Green Tuff region of Japan (Shikazono, 1978); the Wood River Pb-Ag deposits, Idaho (Hall and Czamanske, 1972); the Potosi District, Bolivia (Turneaure, 1960); and the Guanajuato District, Mexico (Buchanan, 1980).

These groupings can be explained by changing solid-liquid-vapor equilibria during the evolution of a dynamic hydrothermal system. Data from studies in solution chemistry and mineral solubilities can be integrated into a possible mechanism for the trace element relationships seen in the type of hydrothermal system being considered. Work by Drummond and Ohmoto (1979) on the compositional evolution of hydrothermal fluids with progressive boiling indicates that the successive partitioning of potential complexing ligands ($CO_2 \rightarrow CH_4 \rightarrow H_2S \rightarrow SO_2 \rightarrow SO_4$) into the vapor phase strongly affects fluid characteristics and mineral solubilities. Buchanan (1980) has demonstrated boiling to be a plausible mechanism for ore deposition in the Guanajuato District, Mexico. Deposition is induced by the instability of chloride complexes resulting from the increase in pH due to CO_2 loss which is accompanied by the precipitation of metals such as Cu, Pb, Zn, and Ag. Hydrogen sulfide tends to remain in solution longer than CO_2, allowing Au (Seward, 1973) and possibly the associated trace elements As and Sb to form sulfide complexes which are stable under the more alkaline conditions. Deposition of metals traveling as sulfide complexes can occur with progressive oxidation of reduced sulfur species, as a result of interaction with oxygenated ground waters or expulsion onto the surface. The solution chemistry of Tl is poorly understood at present, although it has been suggested (Ewers and Keays, 1977) to be entirely temperature dependent. This process is compatible with vertical zoning data from geothermal areas, and trace element and paragenetic data from certain epithermal mineral deposits. While the variables of any particular mineralizing event (e.g. solution chemistry and hydrodynamics) are quite unique, the gross similarities of epithermal systems allow the use of generalized models. A schematic section representing a vertically zoned epithermal system is included as figure 6. As shown, the style of mineralization, nature of mineralization, and trace element suite changes with depth. Base metal sulfides ($\pm$ Au, Ag) in well defined conduits at depth evolve into stockwork, dispersed, and exhalative precious metal mineralization with decreasing depth. The premise of this study is these spatial relationships can be ex-

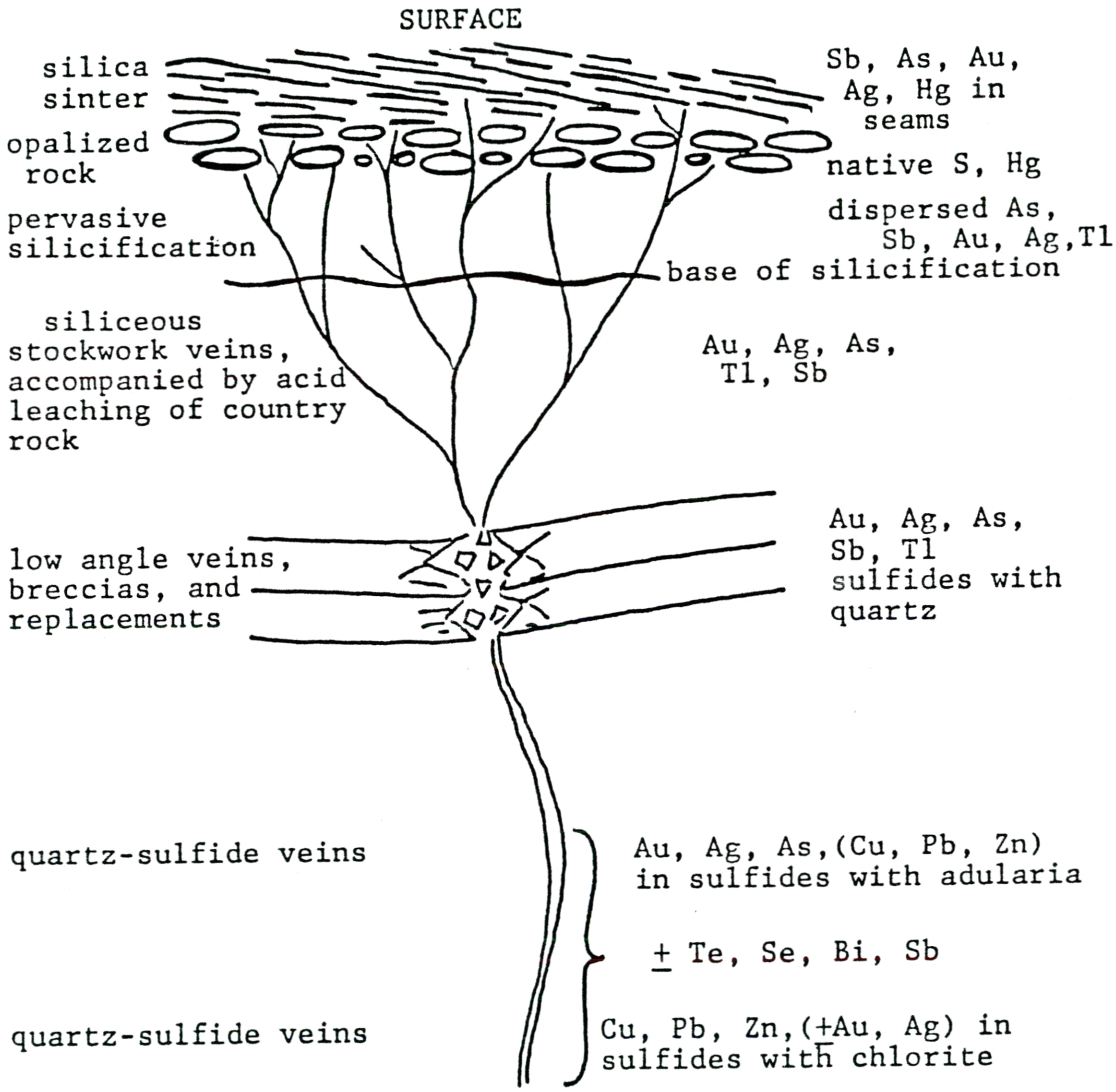


Figure 6) Schematic cross section of the hot-springs depositional model showing the spatial relationships of trace element geochemistry. (After Berger and Eimon, 1982).

ploited geochemically during exploration for precious metal ore deposits.

Purpose and Scope of this Study

The purpose of this study is to define and evaluate trace element indicators of precious metal-bearing fossil geothermal systems. An area in eastern Alpine County, California was determined to be highly anomalous based on regional geochemical studies by the U.S. Geological Survey (Chaffee and others, 1980) in the Walker Lake 1° by 2° quadrangle. This region, having a history of precious metal production from both the Silver Mountain and Monitor-Mogul Districts, was selected to test the generalized epithermal trace element model discussed in the previous section.

Geologic mapping was performed at 1:24,000 to provide sampling control and a basis for geologic interpretations. A variable density sampling 'grid' was designed to detect local zoning trends in addition to the more obvious regional variation. A suite of trace elements (Ag, As, Au, Bi, Sb, Se, Te, and Tl) was selected, the distribution of which appears closely related to the nature and spatial evolution of epithermal systems.

Recent developments in analytical geochemistry (Clark, 1981, 1983) have provided a new technique for flameless atomic absorption spectrophotometry. The 'MAGIC' extraction analytical technique involves a cold digestion and organic extraction and is particularly suited for this application because:

1. The partial extraction is sulfide selective, and therefore produces data directly related to the mineralizing event, thereby easing interpretational complication caused by heterogeneous host rocks;
2. It has good sensitivity and allows for multi-element analysis for elements that occur in relatively low crustal abundance;
3. It has reasonably good precision (typically ± 10% in the threshold range for most of the elements dealt with).

LOCATION AND DESCRIPTION OF THE STUDY AREA

Location

Alpine County is located in east-central California, near the crest of the Sierra Nevada, in a region of rugged alpine terrain. Elevations range from 5000 feet (1525 m) to over 11,000 feet (3350 m) above sea level. A number of mountain peaks and ridges exceed 10,000 feet (3050 m) in elevation. Many peaks lie along the Sierra Nevada crest which transects Alpine County from southeast to northwest.

The Mokelumne and Stanislaus River systems drain the region west of the Sierran divide; while the region east of the divide is drained by the Carson River system. Most streams in the area have a steep gradient and occupy deep, steep-sided canyons which have been locally reshaped by glaciation.

Climate is strongly influenced by the regional alpine topography. Although the area can be collectively described as semi-arid, a definite change from alpine to transitional vegetation occurs as one crosses the crest of the Sierra from west to east, indicating a change toward more arid conditions.

The study area consists of approximately 90 square miles (230 square kilometers) in east-central Alpine County (figure 7), which lies along the eastern margin of the Sierra Nevada physiographic

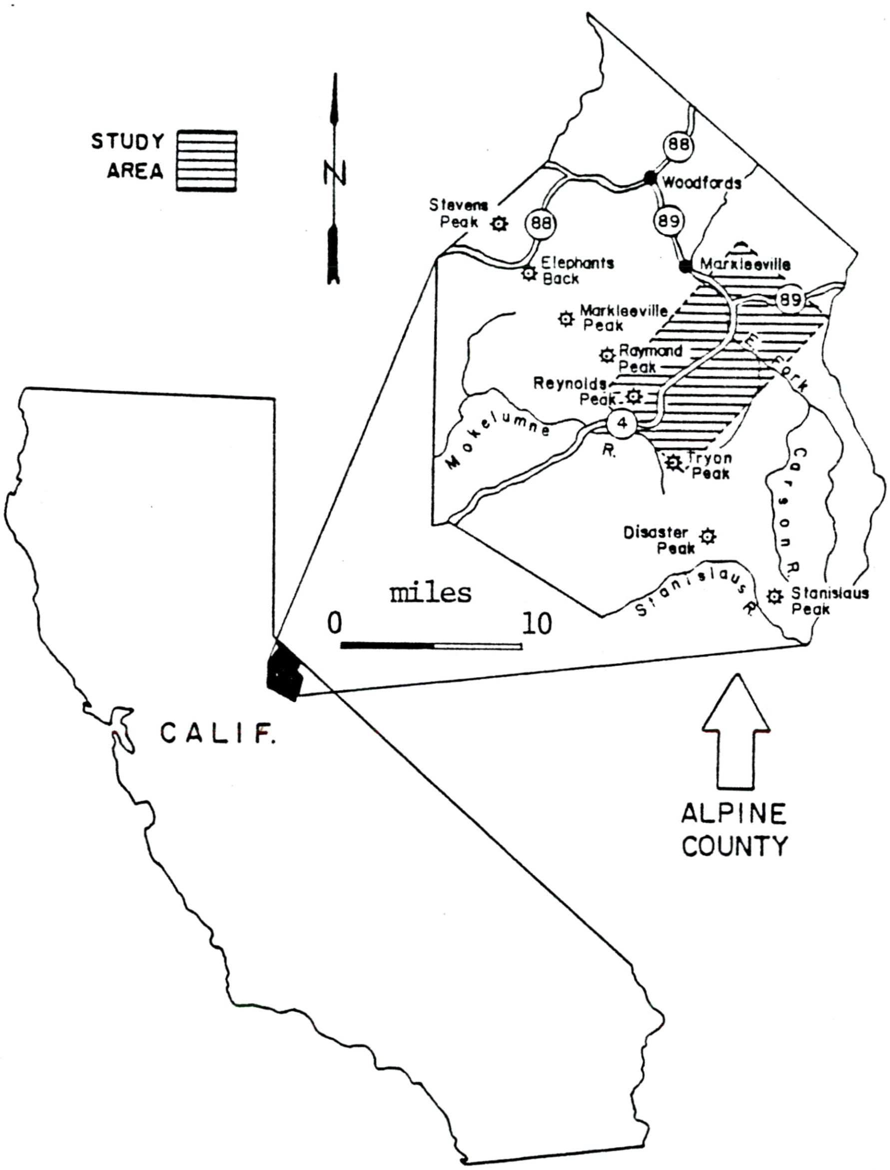


Figure 7) Map of California, showing Alpine County and location of the study area.

province adjacent to the Great Basin (figure 8).

Geology

General Geology

The geology exposed in east-central Alpine County, California is the result of the periodic accumulation of middle to late Tertiary volcanic rocks atop an Eocene (Slemmons, 1966) erosional surface developed upon Cretaceous (Curtis, 1951) granodioritic plutonic rocks of the composite Sierra Nevada Batholith. The Tertiary volcanic history of the central Sierra Nevada has been subdivided by Slemmons (1966) into four major episodes: 1) Eruption of Oligocene to Miocene rhyolitic tuffs of the Valley Springs Formation; 2) Eruption of Miocene to Pliocene andesite flows, breccias, and associated volcanic sediments of the Relief Peak Formation; 3) Deposition of early Pliocene latite to quartz latite flows and tuffs of the Stanislaus Formation; and 4) Eruptions of later Pliocene andesites of the Disaster Peak Formation with late Pliocene or Quaternary basalt and rhyolite.

Stratigraphy

The reconnaissance geologic mapping by the writer in east-central Alpine County (Plate 1) developed a volcanic stratigraphy (figure 9) grossly equivalent to that of Slemmons (1966). However, when viewed on a local scale, deviations in the stratigraphic succession become ap-

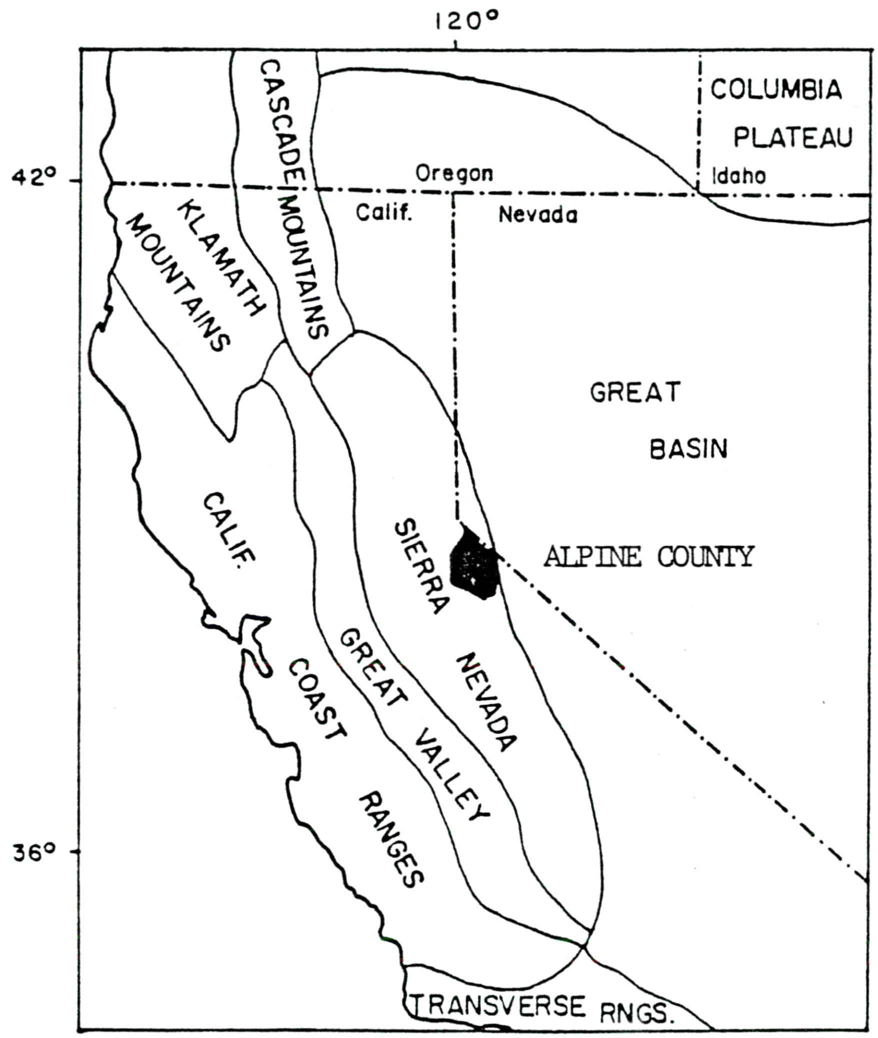
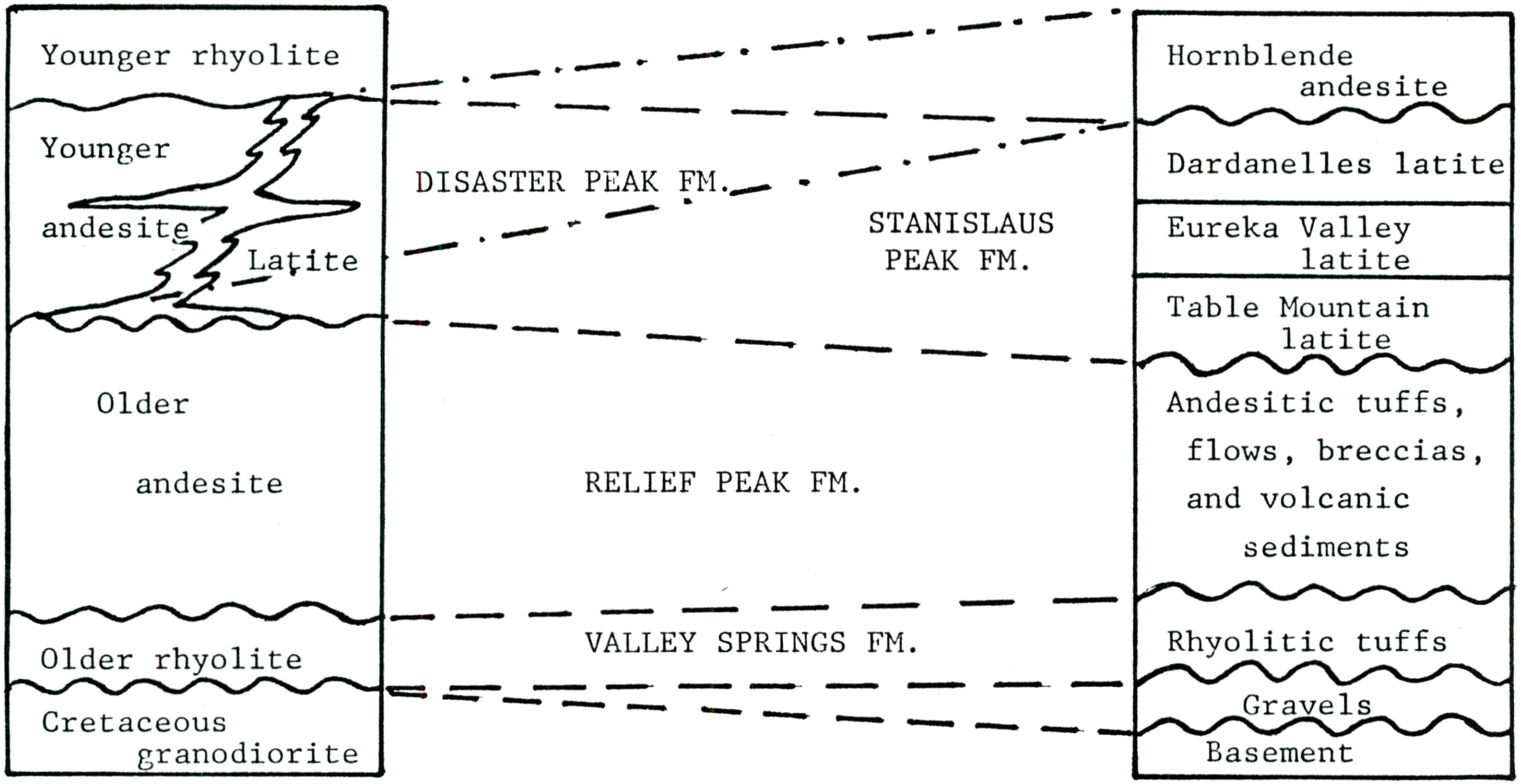


Figure 8) Physiographic location of Alpine County, California. Modified after Stewart (1978).



(A) (B)

Figure 9. Generalized volcanic stratigraphy of east-central Alpine County. As proposed for this study (A) compared to that for the upper elevations of the central Sierra Nevada region (B) proposed by Slemmons (1966).

parent. The complex stratigraphic relationships of the post-Relief Peak Formation equivalent rocks, particularly closer to source areas (e.g. the south-central portion of the study area) support a suggestion by Wilshire (1957) that these rocks represent a calc-alkaline differentiation series deposited through episodic intrusive/extrusive activity.

As shown on Plate 1, the study area is underlain by a granodioritic basement of Cretaceous age (Kgd, see Table 1, f) with a veneer of younger Tertiary volcanic rocks (and equivalent epiclastic rocks) and Quaternary surficial deposits. Six different Tertiary extrusive rock types have been identified, four of which have intrusive equivalents. These six types range in composition from basalt to rhyolite with andesite strongly dominant in terms of volume. No source was identified for the older rhyolite (Tr_1) or basalt (Tb).

<u>Older rhyolite</u> (Tr_1, Table 1, e)

The older rhyolite (Tr_1) is presumably equivalent (figure 9) to the Valley Springs Formation of Slemmons (1966). This rock type constitutes only minor exposures in the study area (sections 20 and 29, T9N, R20E) and is represented by a non-welded ash-flow tuff, which lies unconformably on the granodioritic basement and is in turn overlain by the older andesite unit (Ta_1). The limited extent of roughly aligned exposures of Tr_1 suggest a paleotopographic control of deposition.

a) Tr_2 younger felsic extrusive rocks	dacite tuff breccia, angular fragments (up to 10 cm) in a non-welded vitric matrix	23% plagioclase (An_{28}) 18% hornblende 3% sanidine 3% quartz 53% glass
Tr_2i younger felsic extrusive rocks	biotite rhyolite, microcrystaline, banded rhyolite with radial cristobalite clusters	54% sanidine 44% cristobalite 1½% biotite ½% opaques
b) Ta_2 younger andesite extrusive rocks	hornblende andesite breccia, fragments up to 25 cm in a devitrified glassy matrix	30% plagioclase (An_{50}) 20% hornblende 4% hematite 46% devitrified glass
Ta_2i younger andesite intrusive rocks	hornblende andesite porphyry, hyalopilitic with plagioclase and hornblende phenocrysts in a matrix of microlites and clear glass	22% plagioclase (An_{45}) 7% hornblende 2% magnetite 69% glass
c) Tl latite extrusive rocks	biotite latite vitrophere, hypocrystalline vitrophyric biotite latite porphyry	18% plagioclase (An_{27-30}) 14% biotite 3% sanidine 1% opaques vitric groundmass
Tli latite intrusive rocks	quartz latite porphyry, holocrystalline, porphyritic hornblende-biotite-quartz latite, phenocrysts average 0.75 mm.	25% plagioclase (An_{33-35}) 15% hornblende 7% biotite 2% sanidine 1% quartz in a felty, unoriented groundmass
d) Ta_1 older andesite extrusive rocks	andesite flow breccia, chaotic angular to subangular fragments (avg. 12 cm) with minor fine matrix	55% plagioclase (An_{63}) 40% clinopyroxene 1% epidote 4% magnetite
Ta_1i older andesite intrusive rocks	diorite, fine-grained hypidiomorphic granular texture, average grain size 0.75 mm.	65% plagioclase(An_{50}) 30% clinopyroxene 1% biotite 4% magnetite
e) Tr_1 older felsic volcanic rocks	rhyolite crystal-vitric tuff, non-welded fine-grained crystal tuff, average grain size 0.08 mm	14% quartz 6% sanidine in a devitrified matrix
f) Kgd granodiorite basement	hornblende-biotite granodiorite, medium grained, hypidiomorphic granular, average grain size 2.5 mm	48% plagioclase (An_{22-25}) 21% k'spar 4% chlorite 13% quartz 1% sericite 8% hornblende ½% calcite 4% biotite ½% clinozoisite

Table 1. Representative petrographic properties of geologic map units.

Older andesite (Ta_1, Ta_1i, Table 1, d)

The older andesite unit (Ta_1) consists predominantly of flows and flow breccias that tend to grade laterally into mudflows and epiclastic rocks with increasing distance away from mappable source areas. Minor tuffaceous andesite is present as well. The sources for the older andesite probably were fissures and small feeder zones. Wilshire (1957) proposed that this unit filled large interior basins eventually inundating all but the highest topographic expression.

A gentle erosion surface separates the older andesite from younger latites, andesites, and a dacite to rhyolite sequence. These rocks are presumed equivalent to the latites of the Stanislaus Formation and the andesites of the Disaster Peak Formation, with the dacite to rhyolite sequence heretofore unrecognized in published studies of Tertiary volcanism in the Sierra Nevada.

Latite (Tl, Tli, Table 1, c)

The latite unit (Tli) occurs as a coarsely porphyritic, epizonal intrusive body (sections 15 and 22, T8N, R20E) that grades vertically and laterally into flow and pyroclastic units that exhibit decreasing coarseness with increasing distance from their source. Extensive latite flows are present along the northeast border of the study area.

Younger andesite (Ta_2, Ta_2i, Table 1, b)

The younger andesite unit can be readily distinguished from the older andesite unit. The older unit is pyroxene bearing and accompanied by minor hornblende, while the younger unit is characteristically hornblende-rich and apparently lacking in pyroxene. The younger andesite unit consists of flows, autobreccias equivalent to the Mehrtens Formation described by Curtis (1954), and mudflows.

Younger rhyolite (Tr_2, Tr_2i, Table 1, a)

The rhyolite to dacite sequence seems to result from recurrent intrusive/extrusive activity that is intermittently contemporaneous with the emplacement and deposition of Tl and Ta_2. The variation in composition within Tr_2 correlates with the style of occurrence and chronologic order of appearance in the stratigraphic sequence. The lower parts of the unit are predominantly ash-flows of dacitic composition while the upper parts are characterized by rhyolite flows and exogenous flow-dome complexes.

The erractic and commonly interfingering stratigraphic relationships between Tl, Ta_2, and Tr_2 found in the study area are a deviation from the regional stratigraphic relationships proposed for the post-Relief Peak Formation-equivalent rocks by Slemmons (figure 9b). The units appear to result from episodic activity possibly related to a composite or multiple magmatic system and hence may represent recurrent stages or levels in a differentiated magma body. Although chemical data to support this idea are not available, two marked gravity lows, one in the Monitor-Mogul area and the other in the Highland Peak

-Silver Peak area (Plouff and others, unpublished data), may indicate shallow magma chambers.

Basalt

The minor occurrence of basalt forming Ebbetts Peak (section 18, T8N, R20E) has been tentatively classified as late Pliocene to early Pleistocene in age. The basalt is interpreted to represent the mafic component of the bimodal volcanic suite related to Basin and Range extensional tectonism (for discussion see Stewart, 1978).

Glacial Deposits

Following the uplift of the Sierra Nevada block in the late Pliocene (Christensen, 1966) the central Sierra Nevada region was subjected to alpine-style glaciation during the Pleistocene. Glaciation caused considerable erosion and topographic modification particularly in the major drainages. Minor poorly-sorted till deposits occur along Silver Creek and along the East Fork of the Carson River.

Structure

Rhyolitic intrusive rocks, hydrothermal alteration and precious metal mineralization in the study area are closely related to the development of favorable structures. Structural style changes from southwest to northeast across the study area (see Plate 1). A series of northwest trending normal faults predominate in the southwest. These are characterized by narrow to moderate (10-100 foot, 3-30 meter) fracture zones with a marked increase in alteration and/or weathering relative to adjacent unfaulted rock. The mineralization in the Silver Mountain District is associated with these larger northwest trending faults.

In the northernmost corner of the study area, at the site of the Monitor-Mogul District, structural style becomes more complex. Here rocks are folded and cut by abundant crosscutting, near-vertical faults with little apparent displacement. Pervasive hydrothermal alteration is well developed. Wachter (1971) has interpreted this area as representing the faulted roof of a magma chamber. This interpretation is consistent with available geological and geophysical data.

ECONOMIC GEOLOGY

Two distinct mineralized districts are present in the study area. The Silver Mountain District contains Ag-rich ore shoots, which formed along structures accessory to a northwest trending normal fault. This fault system seems to mark a zone of weakness that was subsequently intruded by a number of rhyolite plugs. The Monitor-Mogul District contains several base and precious metal mines in an intensely structurally deformed area that has also been intruded by several rhyolite bodies.

Mining History

The Silver Mountain District, located in the west-central portion of the study area (see Plate 1), was extensively prospected and developed in the 1860's and 1870's. Predominantly promotional activities of the Isabella Mining Company of London, England, led to failure of these ventures after huge loses were sustained. Total production of the district probably did not exceed $300,000 (Clark, 1977). Small scale development is currently being conducted by a local prospector.

The Monitor-Mogul District is located in the northern-most portion of the study area (see Plate 1). Development work began in the mid-to late 1850's. Sporadic small scale mining of Cu, Pb, Zn, Au, and Ag ores has continued intermittently to the present day. Recent exploration at the Zaca Mine has delineated in excess of one million tons of ore having an average grade of approximately 0.1 ounces gold per ton and 1.0 ounce silver per ton (news release, California Silver LTD, November 20, 1981). The gross value of metals mined to date is uncertain, although likely to be in excess of 2 million dollars.

Silver Mountain District

Style of Mineralization

Precious metal mineralization in the Silver Mountain District occurs in quartz veins, in hydrothermal and tectonic breccias and in zones of jasperoid development that are associated with structures reflecting the major northwest trending normal fault system. Prospecting activities have focused on three major vein systems: the IXL, Acacia, and the Exchequer. These structures are generally north trending and steeply dipping. Ore shoot development has been confined to local, small, dilatant zones and to structural intersections. Syn- and post-mineralization faulting is indicated by locally intense gouge development along veins. Mineralized localities occurring outside the district proper are minor and reflect a similar north to northwest trending structural control. These structures are apparent at the Raymond Meadows Creek Mine, where northwest trending joints in the granodiorite basement have been mineralized. The localization of mineralized structures at the head of IXL Canyon probably reflects structural preparation near the terminus of the IXL Canyon fault. The hydrothermal system was apparently driven by a series of hypabyssal rhyolite plugs that intruded along the IXL Canyon fault.

Mineralization

The following description of mineralization in the Silver Mountain District comes largely from oral and written communication with Mr. Bud Munck (1979, 1980). Mr. Munck controls the district and maintains a small scale exploration and development program of the major vein systems in IXL Canyon.

The IXL vein system ore minerals are acanthite, native silver, proustite, auriferous pyrite, and minor sphalerite. Acanthite and native silver-bearing material characterize the highest grade ore, occasionally exceeding 260 ounces silver per ton and 3 ounces gold per ton. Free gold is apparently absent. The main ore shoot has formed at the intersection of two smaller veins with the main IXL veins.

The Acacia vein system hosts ore comprised of proustite, pyrargyrite, auriferous pyrite, and minor sphalerite. Grades range as high as 60 ounces of silver per ton, with low sporadic gold values. Mineralization is highly irregular and is controlled by zones of dilation along principal structures.

The Exchequer vein system contains an ore shoot comprising prousttite, pyrargyrite, stibnite, pyrite, and free gold. The main ore shoot forms at the intersection of two veins, where the main vein is deflected toward the west. The vein system shows some zoning, with gold being in greater abundance on the lower levels of the mine workings (400 foot level). Grades found in the Exchequer system range to 5000 ounces silver per ton and 100 ounces gold per ton.

Alteration

The vein systems of the Silver Mountain District are characterized by discrete, structurally controlled sulfide-rich zones in a siliceous gangue. The silica gangue occurs predominantly as medium to coarse-grained clear and/or milky quartz crystal aggregates but is also present as pervasive micro- or cryptocrystalline silicification of wall rock in less open segments of the vein. Other gangue minerals include minor, apparently late, calcite and hematite. The structures are flanked by an argillic alteration selvage that ranges from 1 foot (.3 m) to 6 feet (2 m) in width. The development of the argillic selvage is closely proportional to the magnitude of adjacent sulfide mineralization. This argillic selvage grades rapidly into a propylitic alteration assemblage which is pervasive throughout the district.

Monitor-Mogul District

Style of Mineralization

Mineralization in the Monitor-Mogul District occurs as disseminations and stockworks, as veins, and as tabular masses localized along the clay-rich or friable cores of small fold structures.

Recent geophysical studies by the U.S.G.S. (Plouff and others, unpublished data) have delineated a 'bullseye' gravity low centered under the district. Field relationships indicate the emplacement of the rhyolite plugs to have overlapped in time with the culmination of structural deformation and hydrothermal alteration/mineralization. The ore at the Zaca Mine occurs as disseminations and minor stockworks within the rhyolite itself. The rhyolite plug immediately west of the Morningstar Mine (section 30, T10N, R21E) is essentially unaltered and unmineralized. The other rhyolite plugs in the district show moderate hydrothermal alteration but evidence of associated mineralization has not been reported or seen. While the cause of structural deformation may not be collapse related, the concentration of intrusive activity, intensity of hydrothermal alteration, and degree of structural deformation, combined with limited geophysical data, do support the hypothesis of the district being located over the magma chamber that issued the younger rhyolite intrusives (Tr_2i).

Mineralization

Three discrete types of ore occur in the Monitor-Mogul District: 1) disseminated/stockwork mineralization as at the Zaca Mine; 2) large tabular lodes associated with folds and faults in the vicinity of the Morningstar and Curtz Mines; and 3) vein-type mineralization as seen at the numerous smaller mines and prospects throughout the district.

Disseminated and stockwork-type mineralization at the Zaca Mine consists of small grains and veinlets of quartz, pyrite, sphalerite, chalcopyrite, galena, tetrahedrite, and free gold. Minor constituents include pyrargyrite, huebnerite, and molybdenite. Supergene minerals (e.g. covellite, cerargyrite) are common in the near surface environment. Grades mined range from 14 ounces silver equivalents per ton to 1000 ounces silver equivalents per ton (Wachter, 1971). Gangue is dominated by quartz, pyrite, and rhodochrosite.

The large irregular sulfide body developed at the Morningstar and adjacent mines was stoped from 465 feet (145 m) to within 20 feet (6 m) of the surface. This body occurs along a series of intersecting faults and is overlain by a silicified caprock ranging from jasperoid to siliceous gossan, which appears to have developed as hydrothermal fluids migrated outward along a favorable stratigraphic horizon. This caprock may have subsequently served as a permeability barrier for later metal-bearing solutions. The ore resembles that found in the other mines in the district except that enargite is relatively more abundant. Other sulfides include chalcopyrite, pyrite, sphalerite, galena, and arsenopyrite. Gangue minerals appear to be exclusely pyrite and quartz. A dump sample collected by Wachter (1971) from the Morningstar Mine assayed 16 percent copper, 50 ounces silver per ton, and 0.5 ounces gold per ton.

Vein-type mineralization is widespread throughout the district, but little recent prospecting activity has occurred. Numerous small mines and prospects, probably dating back to the early days of the district, are developed on small vein exposures. Surface geology and sketchy historical records (Clark, 1977) suggest that these veins are generally lower grade occurrences of chalcopyrite, sphalerite, galena, and minor tetrahedrite along the major fault structures throughout the district.

Alteration

The extent of hydrothermal alteration in the Monitor-Mogul District is defined by an argillic assemblage which is roughly concentric around the district. A zone approximately 1.8 miles (3 km) by 4 miles (6 km) in size and dominated by kaolinite and/or montmorillonite-group clays extends to the northwest from just north of Silver Hill (section 8, T10N, R21E). The intensity of argillic alteration increases along conduit structures and adjacent to the rhyolite plugs in the vicinity of the Zaca Mine. The argillic facies grades outward into a propylitic assemblage. Local 'islands' of propylitized rock are present within the district where faulting is of low density.

Proximal alteration in the district is present as two distinct mineral assemblages. In and around the Zaca Mine, a sericitic (± quartz and pyrite) alteration assemblage occurs in the rhyolite and extends for a short distance into the adjacent andesite. Elsewhere in the district, mineralized structures are marked by intense silicification accompanied by ubiquitous pyrite. This silicification appears to blossom out along a tuffaceous horizon in the lower andesite, thus forming a jasperoid as the caprock at the Morningstar Mine (see Plate 1). This style of silicification is also pyritic and locally is accompanied by significant base and precious metal concentrations. The jasperoids in the Monitor-Mogul District are often quite extensive (up to 500 feet (154 m) by 5000 feet (1540 m)) and form spectacular exposures along ridgelines.

Synthesis

The contrasting styles of mineralization in the Silver Mountain and Monitor-Mogul Mining Districts offer an opportunity to evaluate the baseline trace element dispersion model. The well contained alteration and dominantly sulfosalt mineralization present in the Silver Mountain District should produce a limited geochemical response. The Silver Mountain District vein systems represent the equivalents of the base and precious metal-bearing veins in Berger and Eimon's (1982) generalized hot spring system model. Mineralization in the Monitor-Mogul District is more diverse in style and is more well developed overall. A well developed, probably zoned, geochemical response is expected from the extensive fossil geothermal system in the Monitor-Mogul District. When viewed in reference to Berger and Eimon's (1982) model (see figure 6, p. 12) the Monitor-Mogul District appears to represent a strongly telescoped, and partially superimposed, hot spring-type hydrothermal system.

GEOCHEMISTRY

Sample Collection

Rock chip samples (of approximately 2 lb or 1000 g each) were collected at the 266 sites shown on Plate 2. Samples were hand cobbed in the field to remove any obvious surface weathering. At sites where sample materials were heterogeneous, composite samples were collected. Duplicate samples were collected at 23 sites (8.65% of total) to provide the data base for the statistical analysis of variance (ANOVA).

Sample Preparation

Using the sample preparation facilities in the Colorado School of Mines, Geology Department, samples were crushed in a BRAUN jaw crusher, and pulverized in a BUELER 'shatterbox' (using a steel puck and disk) for 2 to 3 minutes. This procedure brought the sample material size to less than 15% greater than -200 mesh. Pulps, stored in cardboard containers, were used in the subsequent digestion and extraction procedures.

Analytical Procedure

The 'MAGIC' extraction analytical procedure developed by Clark

(1981) is summarized in figure 10. Table 2 shows the analytical parameters for each element analyzed. Each sample aliquot was accompanied by an equal volume of a specific matrix modifying solution upon atomization. The matrix modifying solution serves to enhance the quality of atomization by reducing the interference effects of the matrix solution and other elements present in the sample. All analyses were done using the heated graphite atomizer (HGA) on a PERKIN-ELMER model 360 atomic absorbtion spectrophotometer. Analyses were performed by the author using the analytical facilities at the Colorado School of Mines.

Analytical results were computed from calibration curves construct- for each element from data derived using a range of standards made from high purity stock solutions. Standards were analyzed using the identical procedure as used for the digested rock samples (figure 10). A standard was analyzed with every tenth sample to detect any potential drift during the course of an analytical session. Analysis of one of the eight elements was completed on all the samples during a single analytical session so as to minimize variability. A series of blank samples were similarly prepared to monitor any inherent contamination. Contamination was below the detection limit for all elements.

Analytical Precision

Analytical precision refers to the reproducibility of geochemical data and serves as one measure of laboratory quality. Duplicate analy-

Sample Digestion

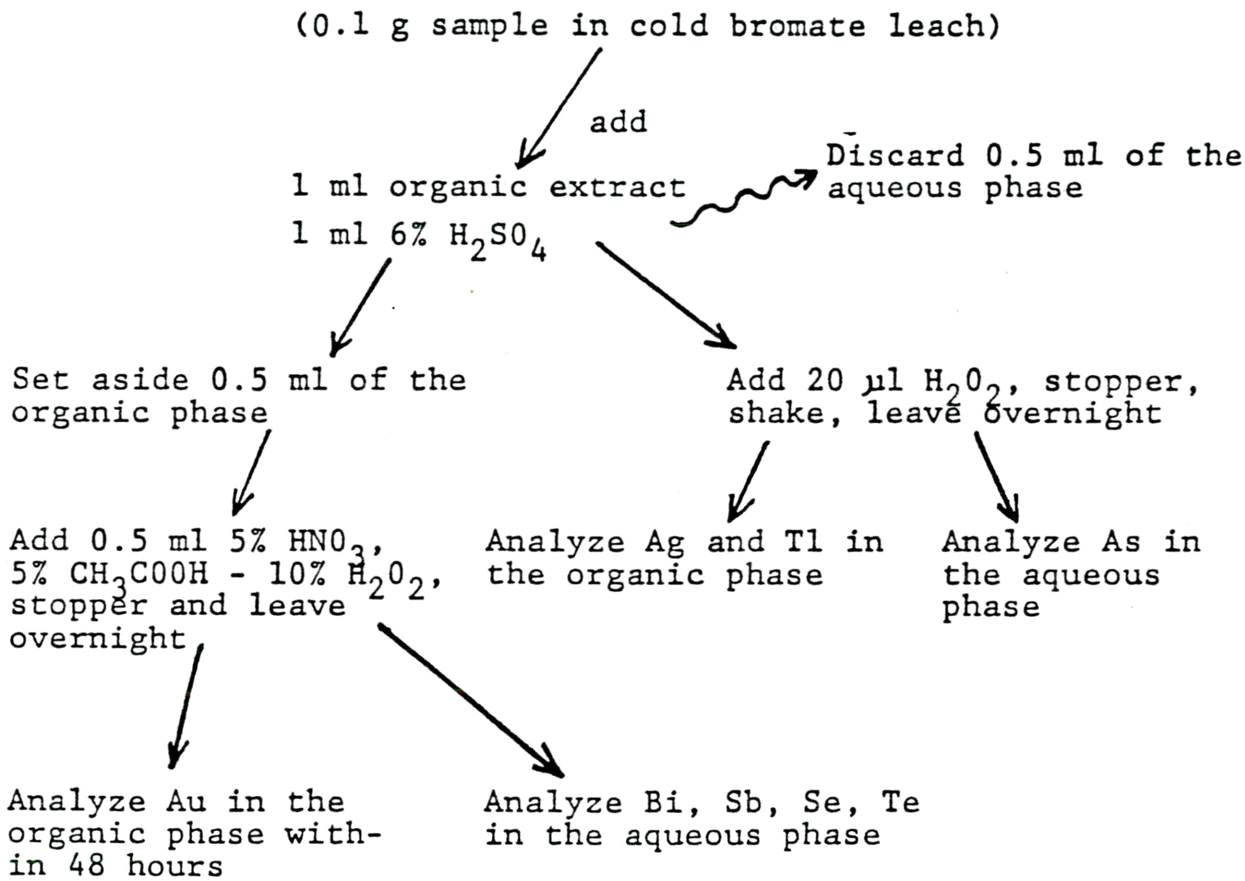


Figure 10. Flow chart summary of the MAGIC extraction sulfide selective analytical technique for flameless AA (Clark, 1981).

Parameter	Element	Ag	As	Au	Bi	Sb	Se	Te	Tl
Tube Wavelength		328.1nm	193.7nm	242.8nm	223.1nm	217.6nm	196nm	214nm	276.8nm
Slit Setting		0.7nm	0.7nm	0.7nm	0.2nm	0.2nm	0.7nm	0.2nm	0.7nm
Gas Flow		100	45	35	35	45	45	35	35
Drying Cycle		10 sec. 85°C	15 sec. 95°C	12 sec. 95°C	12 sec. 105°C	13 sec. 105°C	12 sec. 105°C	12 sec. 105°C	10 sec. 85°C
Charring Cycle		20 sec. 800°C	15 sec. 1000°C	22 sec. 1200°C	12 sec. 900°C	16 sec. 600°C	14 sec. 1000°C	14 sec. 900°C	22 sec. 1000°C
Atomizing Cycle		6 sec. 2600°C	7 sec. 2500°C	10 sec. 2700°C	8 sec. 2600°C	7 sec. 2600°C	9 sec. 2700°C	6 sec. 2700°C	7 sec. 2500°C
Sample Size		5 ul	10 ul	10 ul	5 ul	10 ul	5 ul	5 ul	5 ul
Matrix Modifier		5 ul of: 5% SCN 1% ascorbic acid 1% VO_3 in methanol	10 ul of: 1000 ppm Ni soln.	10 ul of: .2% V_2O_5 5% NH_4 citrate 100 ppm Cu 30% H_2O_2 in H_2O	5 ul of: 5% NH_4 citrate 1% NH_4WO_3 200 ppm Cu in H_2O	10 ul of: 1000 ppm CrO_3 200 ppm Cu 30% CH_3COOH in H_2O	5 ul of: 2% V_2O_5 5% NH_4 citrate 1% H_2O_2 100 ppm Cu in H_2O	5 ul of: 100 ppm Cu 200 ppm Ni 30% CH_3COOH in H_2O	5 ul of: 1000 ppm CrO_3 in H_2O

Table 2. Spectrophotometer parameters for HGA analyses.

ses were performed on a series of samples (14% of total). The results were used to compute the analytical precision for the entire data set following the procedure of Garrett (1969, 1973). Raw and $\log_{10}$ transformed analyses were used in the computations; the results are indicated in Table 3. Because the single element histograms (see Appendices B and C) indicate strong positive skewing, the analytical precision of the $\log_{10}$ transformed data more closely represents actual precision.

As discussed by Closs and Sado (1981), a generally accepted level of precision is $\pm$ 15% at the 95% confidence level. Calculated precision levels in excess of $\pm$ 15% require additional evaluation prior to geologic interpretation. If a major proportion of the geochemical data is near the detection limit of the analytical method employed, where precision is typically reduced and small changes in metal concentrations represent relatively high percentage differences, the computed analytical precision can be misleading. In this situation an accurate estimate of analytical precision can not be determined for the higher concentration ranges. Interpretation should then be based on a thorough evaluation of the data base.

Computed precisions for the $\log_{10}$ transformed data (Table 3) fail to fall within the generally accepted $\pm$ 15% range. In the cases of Ag, As, Au, Bi, Sb, Se, Te, and Tl, the majority of the results fall near the analytical detection limit and, as discussed above, it is not possible to calculate a valid precision estimate for the range of values determined for each element. Comparison of duplicate analyses having

Table 3. Precision [1,2] of Trace element Analytical Data, East-Central Alpine County, California

Element	Original Data	Log_{10} Transformed Data	Detection Limit (ppm)	Range (ppm)
Ag	56.41	-45.57	0.002	0.002-1.2
As	290.22	-88.37	0.02	0.02-23
Au	252.14	-21.19	0.002	0.002-0.083
Bi	110.75	-23.93	0.005	0.005-.035
Sb	60.36	-47.80	0.001	0.001-0.91
Se	430.92	-25.58	0.002	0.002-3.9
Te	928.49	-43.61	0.001	0.001-0.25
Tl	135.60	-21.59	0.002	0.002-0.22

1. Expressed in percent, at the 95% confidence level after the procedure of Garrett (1969, 1973).

2. Based on duplicate analysis of 46 samples.

concentrations in the range of high background to anomalous values indicates a reproducibility in the accepted range. The use of the data for interpretive purposes is therefore considered valid.

Data Processing Procedures

Field and analytical data were keypunched onto computer cards. Basic statistical parameters and histograms were computed for both raw and $\log_{10}$ transformed values. Distribution of variance was determined for both raw and $\log_{10}$ transformed values using an analysis of variance program. A correlation analysis was similarly performed.

RESULTS

Basic Statistics

Basic statistical parameters, including range, mean, and standard deviation, are summarized in Table 4. These statistics have been computed for each of the eight elements using both raw and $\log_{10}$ transformed values. The influence of the positively skewed distribution on the statistical parameters of the raw and $\log_{10}$ transformed data is shown in Table 4.

Interpretational Considerations

The initial step in the interpretation of exploration geochemical data is to determine a realistic threshold value. In mineral exploration the threshold value is defined to distinguish mineralized from non-mineralized sample poulations. In practice the threshold is the value in a data set which separates background from anomalous concentrations.

Should the data set approximate a normal (or lognormal) frequency distribution, the threshold value can be determined using statistical criteria such as the mean and standard deviation. In a normal distribution, the threshold value is often defined as the mean plus two times

Table 4. Statistical Parameters for Lithogeochemical Data, East-Central Alpine Co., California. (N = 266)[1]

Parameter	Ag	As	Au	Bi	Sb	Se	Te	Tl
	Element							
Range (W)	.002-94	.02-8300	.002-7.0	.005-23	.001-395	.002-29	.001-14	.002-0.35
Arithmetic Mean ($\bar{X}$)	1.25	57.48	.069	0.33	7.56	0.46	0.18	0.032
Standard Deviation (S)	9.19	536.23	0.52	2.26	34.14	2.13	1.18	0.050
$\bar{X}$ + 2S	19.63	1129.94	1.11	4.85	75.84	4.72	2.54	0.132
Logarithmic Mean ($\bar{X}_L$)	-1.39	-0.35	-2.33	-1.80	-0.56	-1.56	-2.05	-1.94
Geometric Mean (G)[2]	0.041	0.45	0.0047	.016	0.28	0.28	0.0089	0.016
Standard Deviation (S_L)	0.84	0.98	0.66	0.69	0.90	0.91	0.82	0.64
$\bar{X} + 2S_L$[3]	0.29 (1.95)	1.61 (40.74)	-1.01 (0.10)	-0.42 (0.38)	1.24 (17.38)	0.26 (1.82)	-0.41 (0.39)	-0.66 (0.22)

1) All data in ppm

2) Anti-log of X_L

3) Anti-logs in parentheses

the standard deviation (Rose and others, 1979, p. 39). In situations where the data exhibit a skewed distribution (commonly the case in mineralized areas) the threshold value may be determined visually from a histogram and/or a cumulative frequency plot (Rose and others, 1979, pp. 35 - 40). The selection of threshold values should ideally combine geologic knowledge with statistical parameters.

Reliability is also an important consideration in the evaluation of geochemical data. Prior to the interpretation and prior to any follow-up expenditure, it is wise to compute the reliability of the data. That is, are the results reproducible, representative, and indicative of mineralized areas. An evaluation of data reliability, and hence usefulness as geochemical mapping parameters, was examined using analysis of variance (ANOVA) and correlation analysis. These evaluations represent a potentially critical step in justifying the expense of detailed evaluation follow-up.

Distribution of Trace Elements in Rock Chip Samples

The areal distributions of Ag, As, Au, Bi, Sb, Se, Te, and Tl in rock chip samples are presented as geochemical maps (Plate 3), and are outlined in this section. The histogram plots and data classification scheme are included with each respective geochemical map. Complete analytical and statistical results are included as appendices A through D. A more detailed discussion of distribution patterns is presented in the following section.

Silver

The histogram plot for silver shows a positively skewed distribution with the majority of samples containing less than 0.35 ppm ($\log_{10}$ 0.35 = -0.46). Silver values less than 0.35 ppm are therefore considered background values. Data for silver have been broken down into the following intervals: 1) strongly anomalous - greater than 5.2 ppm ($\log_{10}$ 5.2 = 0.72), the 98th percentile; moderately anomalous - 1.25 to 5.2 ppm ($\log_{10}$ 1.25 = 0.10), the 95th to 98th percentile; 3) weakly anomalous - 0.35 to 1.25 ppm, the 90th to 95th percentile; and high background - 0.10 to 0.35 ppm ($\log_{10}$ 0.10 = -1.0). The highest density of anomalous silver values occurs in the northernmost part of the study area, reflecting mineralization in the Monitor-Mogul District. Several other single or two-point anomalies are scattered throughout the study area.

Gold

The distribution of gold analyses also shows positive skewness, with the major portion of the data set at the detection limit (0.002 ppm). Values have been contoured as follows: 1) strongly anomalous - greater than 0.21 ppm ($\log_{10}$ 0.21 = 0.68), the 98th percentile; moderately anomalous - 0.10 to 0.21 ppm ($\log_{10}$ 0.10 = -1.0), the 95th to 98th percentile; 3) weakly anomalous - 0.06 to 0.10 ppm ($\log_{10}$0.06

= - 1.22), the 90th to 95th percentile; and 4) high background - 0.015 to 0.06 ppm ($\log_{10}$ 0.015 = - 1.82). Anomalous gold values show a clustering corresponding to mineralization in the Monitor-Mogul District. Numerous additional single-point anomalies are present, primarily along the western portion of the study area.

Arsenic

As shown on Plate 3, the arsenic distribution shows strong positive skewing with most samples containing less than 7.5 ppm ($\log_{10}$ 7.5 = 0.88). Contour intervals have been defined as follows: 1) strongly anomalous - greater than 250 ppm ($\log_{10}$ 250 = 2.4), the 98th percentile; 2) moderately anomalous - 71 to 250 ppm ($\log_{10}$ 71 = 1.85), the 95th to 98th percentile; 3) weakly anomalous - 7.5 to 71 ppm, the 90th to 95th percentile; and high background - 1.5 to 7.5 ppm ($\log_{10}$ 1.5 = 0.18). Similar clustering of arsenic anomalies is indicated in the northern part of the study area. Single and two-point anomalies are scattered along the western margin of the field area.

Antimony

Most samples collected contain less than 10.5 ppm antimony ($\log_{10}$ 10.5 = 1.02). The distribution profile is positively skewed. Contour intervals have been defined as follows: 1) strongly anomalous - greater than 88 ppm ($\log_{10}$ 88 = 1.94), the 98th percentile; 2) moderately anomalous - 50 to 88 ppm ($\log_{10}$ 50 = 1.70), the 95th to 98th percentile; 3) weakly anomalous - 10.5 to 50 ppm, the 90th to 95th percentile; and high background - 2.0 to 10.5 ppm ($\log_{10}$ 2.0 = 0.30). An extensive, fairly continuous anomaly is present in the northeastern portion of the study area. Weaker anomalies were detected immediately to the south. These reflect mineralization in the Monitor-Mogul District. Two additional anomalies were detected, reflecting mineralization in the Silver Mountain District.

Selenium

The histogram for selenium distribution in rock chip samples (see Plate 3) shows a well developed bimodal population. The higher concentration population is interpreted to represent the manifestations of hydrothermal mineralization overprinting, and in direct contrast to, the larger background population. Contour intervals have been established as follows: 1) strongly anomalous - greater than 5.2 ppm ($\log_{10}$ 5.2 = 0.72), the 98th percentile; 2) moderately anomalous - 1.8 to 5.2 ppm ($\log_{10}$ 1.8 = 0.26), the 95th to 98th percentile; 3) weakly anomalous 0.86 to 1.8 ppm ($\log_{10}$ 0.86 = 0.07), the 90th to 95th percentile, and 4) possibly anomalous (includes high background) - 0.10 to 0.86 ppm ($\log_{10}$ 0.10 = -1.0). The selenium distribution defines a broad anomalous zone encompassing a large portion of the argillic alteration in the Monitor-Mogul District. Numerous additional, mostly single point anomalies, are scattered across the study area.

Thallium

The thallium population approximates a lognormal distribution, although a large number of samples had thallium concentrations close to the analytical detection limit (0.002 ppm). The data were contoured as follows: 1) strongly anomalous - greater than 0.20 ppm ($\log_{10}$ 0.20 = -0.70), the 98th percentile value; 2) moderately anomalous - 0.15 to 0.20 ppm ($\log_{10}$ 0.15 = -0.82), the 95th to 98th percentile; 3) weakly anomalous - 0.10 to 0.15 ppm ($\log_{10}$ 0.10 = -1.0), the 90th to 95th percentile; and 4) high background - 0.02 to 0.10 ppm ($\log_{10}$ 0.02 = -1.7). A broad thallium anomaly occurs in the southwest portion of the study area, coincident with weak, joint-controlled alteration of the basement granodiorite. Smaller clusters occurring in the south-central part of the study area are related to an altered granitic intrusive body. Small anomalies are also present in the Monitor-Mogul District. Numerous single-point anomalies are scattered throughout the study area.

Bismuth

Bismuth exhibits a strongly positively skewed distribution. Contour intervals have been established as follows: 1) strongly anomalous - greater than 1.5 ppm ($\log_{10}$ 1.5 = 0.18), the 98th percentile; 2) moderately anomalous - 0.60 to 1.5 ppm ($\log_{10}$ 0.60 = -0.22), the 95th to 98th percentile; 3) weakly anomalous - 0.13 to 0.60 ppm ($\log_{10}$ 0.13 = -0.89), the 90th to 95th percentile; and 4) high background - 0.03 to 0.13 ppm ($\log_{10}$ 0.03 = -1.52). Three clusters of anomalous samples occur in the Monitor-Mogul District. Numerous single-point anomalies are present along the northwestern half of the study area.

Tellurium

A bimodal tellurium population is indicated by the histogram plot. The threshold value has been chosen as 0.14 ppm, which corresponds to the 90th percentile value of the cumulative frequency distribution. Tellurium data have been contoured as follows; 1) strongly anomalous - greater than 1.4 ppm ($\log_{10}$ 1.4 = 0.15), the 98th percentile; 2) moderately anomalous - 0.33 to 1.4 ppm ($\log_{10}$ 0.33 = -0.48), the 95th to 98th percentile; 3) weakly anomalous - 0.14 to 0.33 ppm ($\log_{10}$ 0.14 = -0.85), the 90th to 95th percentile; and 4) high background - 0.03 to 0.14 ppm ($\log_{10}$ 0.03 = -1.52). Clusters of anomalous samples are present in the Monitor-Mogul District. Predominantly single-point anomalies are scattered throughout the study area.

DISCUSSION

The purpose of this study was to evaluate a conceptual model concerning the trace element distribution accompanying the formation of low to moderate temperature (less than 350° C) hydrothermal precious metal mineralization. The scope of the investigation was to determine if the combined application of the sulfide-selective analytical technique (MAGIC extraction) with the chosen suite of trace elements was an efficient and practical method of lithogeochemical prospecting for hydrothermal precious metal deposits. The evaluation consisted of four phases, an assessment of: 1) the analytical reproducibility of the geochemical data; 2) the reliability of the geochemical maps; 3) the reationships between trace element distribution patterns and geologic features; and 4) the utility of the sulfide selective analytical technique as a cost effective method of analysis when used in precious metals exploration. Phases 1 - 3 will be discussed under the sections entitled, "Geochemical Data Assessment", and "Summary of Geochemical Results". Phase 4 will be discussed in the final section.

Geochemical Data Assessment

Analytical Reproducibility

Analytical precision or reproducibility was computed using duplicate analyses performed on duplicate samples collected randomly throughout the study area. As discussed previously, all trace element populations showed other than normal distribution profiles. Combined with the fact that Au, Bi, Te, and Tl populations contain a large proportion of samples with concentration levels at or very near their respective detection limits (Au - 183 samples, Bi - 105 samples, Te - 52 samples, and Tl - 178 samples), precision estimates are considered more realistic when calculated using $\log_{10}$ transformed data (Table 3, p. 41). Although overall precision estimates fail to fall within the generally accepted $\pm$ 15% range, this is considered due to the highly skewed nature of the distribution and the influence on the calculated statistical parameters. For example, the following precision estimates were obtained for 14 samples with trace element concentrations within or exceeding the high background range; Ag - 9.86%, As - 8.5%, and Se - 11.75%. Similar results, albeit with a smaller population size, were obtained for Au and Tl. As will be discussed in the next section, the variance of Bi and Te analyses exceeds an acceptable limit, and is therefore statistically not suited for anomaly follow-up. The precision of the other elements is, however, statistically qualified for continued evaluation.

Map Reliability

The reliability of geochemical data can be determined by evaluating the relative magnitude of individual variability parameters (Miesch, 1967, 1976). Data variability for geochemical programs can be comprised of three components; 1) analytical variability (laboratory precision); 2) sampling variability (site heterogeneity and/or sampling error); and 3) regional (between site) variability. Regional variability is the desired component in producing reliable, stable geochemical maps. Regional variability is the residual variance after analytical and sampling variability have been subtracted from the total variance. Partitioning of the total variance into the three principal components can be accomplished using a nested analysis of variance model (Davis, 1973, pp. 106 - 109). The statistical significance of variance partitioning is evaluated using the F-ratio test (Davis, 1973, pp. 99 - 105) at the 95% confidence level.

The analysis of variance computations for $\log_{10}$ transformed data are presented in Table 5. The three principal components of variability for each element have been expressed as a percentage of the total. Where the computed F-ratio value exceeds the critical F-ratio value, a statistically significant partitioning of variance exists between the two components being considered. Where the computed F-ratio value is less than the critical value, there is no statistically significant difference between the two sources of variance being examined. For instance, if the F-ratio value comparing regional and sampling variability is less than the critical F-ratio value, it would be impossible to distinguish between the two sources of variance and that particular trace element would not be a reliable parameter for geochemical mapping (Closs and Sado, 1981).

Table 5. Analysis of Variance Results for Rock Chip Samples, East-central Alpine Co., California. Log_{10} Transformed Data (N = 23).

Trace Element	Apportionment of Data Variability (in percent)			Statistical Significance (F Ratio)	
	A. Regional	B. Sampling	C. Analytical	A/B F_1 DF = (22,23)	B/C F_2 DF - (23,46)
Ag	58.12	20.68	21.19	4.72	2.95
As	77.74	10.76	11.50	10.41	2.87
Au	61.30	5.61	33.10	12.20	1.51
Bi	1.42	19.20	79.39	1.05	1.48
Sb	62.01	12.01	25.98	127.41	13.24
Se	81.81	6.96	11.23	14.01	2.24
Te	11.70	3.46	84.85	1.60	1.09
Tl	72.93	15.68	11.39	7.83	3.75

F_1 Critical @ 95% confidence level = 2.03 for DF = (22,23

F_2 Critical @ 95% confidence level = 1.76 for DF = (23,46)

DF= Degrees of Freedom

N= Number of sites sampled in duplicate.

A statistically significant partitioning of Ag, As, Sb, Se, and Tl variance exists between both regional and sampling variability and between sampling and analytical variability (Table 5). Gold data variances have been significantly partitioned into regional and sampling components, but it is not possible to discriminate between sampling and analytical variability. All of the above elements are statistically reliable geochemical indicators, and thus feasible as mapping aids. In the cases of Bi and Te, it is not possible to discriminate between regional and sampling variability and the data are considered unreliable for geochemical mapping. Subsequent evaluation and interpretation of the geochemical data deliberately stress the Ag, As, Sb, and Tl data, although the Bi and Te results are used to provide some conceptual insights. Such a decision, from a practical point of view, will avoid expenditure on any follow-up of initially unreliable data and will isolate sources of variance so as to streamline future investigations.

Geochemical Results

Monitor-Mogul Mining District

As discussed under 'Economic Geology', the most significant known mineralization in the district occurs at the Morningstar and Zaca Mines (section 29, and SE¼ section 31, T10N, R21E, respectively, see Plate 1). Other known mineralization in the district has failed to generate any sustained interest.

On Plate 3, the Morningstar structural/alteration system is marked by coincident Ag, As, Au, Sb, Se, and Tl anomalies. While not statistically reliable, Bi and Te show a similar distribution pattern. The highest Ag, As, Au, Sb, and Se values (94 ppm, 2430 ppm, 3.9 ppm, 395 ppm, and 29 ppm, respectively) are centered on the jasperoid caprock in the vicinity of the Morningstar Mine. The Tl anomaly (up to 0.35 ppm) is centered further to the northwest and occurs in the structural hanging-wall of the jasperoid. A parallel jasperoid body, approximately one-half mile (0.8 km) to the northwest of the Morningstar Mine is characterized by a linear Ag, As, Sb, and Se (plus Bi and Te) anomaly. Gold and Tl are present as weak single-point anomalies. The Morningstar Au, As, Se (and Bi, Te) anomalies show lateral continuity to the southwest. Only weak, sporadic Ag, Sb, and Tl anomalies are present in this area. The geology to the west of the Morningstar Mine is characterized by intense, pervasive argillic alteration, with numerous small siliceous structures and stockwork zones.

Mineralization at the Zaca Mine is also reflected by multi-element anomalies. Mineralization occurs largely as disseminations and stockworks in the rhyolite itself and probably developed during the intru- of the plug. Geochemical signatures provide a means for distinguishing the rhyolite-hosted mineralization from the structurally controlled, andesite-hosted, mineralization found elsewhere in the district. The rhyolite plug is the focus for a coincident Ag, Au, Sb, and Tl anomaly (values to 94 ppm, 7 ppm, 51 ppm, and 0.21 ppm, respectively) with largely peripheral As and Se anomalies. Note that Bi and Te occur in background concentration levels in the immediate vicinity of the Zaca Mine. Silver and Tl, and to a lesser degree Au, are the only elements showing significant dispersion away from the center of mineralization. Of particular interest is the extensive Tl anomaly in the overlying andesite.

In the vicinity of the Silver Hill Mine (NW¼ SW¼, section 5, T9N, R21E, see Plate 1), a southwest-trending jasperoid body is accompanied by coincident As, Sb, Se, and Tl anomalies with values to 30 ppm, 50 ppm, 1.4 ppm, and 0.12 ppm, respectively (with Bi to 23 ppm and Te to 0.16 ppm), No significant Ag or Au values were detected.

Approximately one-half to two miles (one to three kilometers) east-southeast of the Zaca Mine, a zone of moderate to strong structural disruption with localized intense hydrothermal alteration is indicated by a fairly continuous As and Se anomaly (200 ppm and 3.9 ppm, respectively). The As anomaly is slightly displaced to the east. Sporadic anomalous Sb (and Bi and Te) values are associated with the Se high, while Ag and Au do not exceed high background levels. More pronounced Sb, Ag, and Au (with sporadic Tl) anomalies are associated with the As anomaly immediately to the east.

Other anomalies in the greater Monitor-Mogul area reflect small localized zones of hydrothermal alteration. None of these possess obvious economic significance, and on the scale of this study, do not indicate any apparent geochemical zonation relationships.

Silver Mountain Mining District

The Silver Mountain District, as historically defined, is located in section 16, T9N, R20E (see Plate 1). As discussed here, several very similar occurrences within three miles (five km) to the west and southwest will also be included. The district proper exhibits a localized Ag, Au, As, and Sb anomaly with a broader coincident Tl anomaly, indicating relatively greater Tl mobility. Values range to 0.48 ppm Ag, 8300 ppm As, 0.20 ppm Au, 90 ppm Sb, and 0.24 ppm Tl. One single-point high background Se value was determined with Bi showing sporadic low values and Te being in the background range. Similar relationships were found to exist in the small vein structures to the west and southwest of the district proper. Silver, As, Au, and to a lesser extent Sb and Tl, show a good spatial correlation with mineralized structures. No significant accompanying Se, Bi, and/or Te patterns were defined. In the vicinity of the common corners of sections 28, 29, 32, and 33, T9N, R20E (see Plate 1) a northwest trending fault-bounded zone approximately one by two and one-half miles (1.5 by 4 km) in size is marked by sporadic low-magnitude multi-element anomalies. These anomalies corespond to poorly developed altered structures at or near the basement-volcanic rock interface and do not appear to be economically significant.

Other Significant Anomalies

Four additional, potentially significant anomalies were detected in the study area:

1) In the extreme western corner of the study area, a broad zone of pervasive propylitic alteration is accompanied by local argillic alteration and jasperoid development. No well-developed structures were identified during the cursory field examination. A coincident Ag (24 ppm), Au (0.04 ppm), As (15 ppm), and Se (3.6 ppm) anomaly is flanked on the southeast by a weak gold anomaly. An adjacent high background thallium zone is present to the east. Favorable alteration and geochemical signatures suggest the potential for a mineralized system similar to the Morningstar type.

2) A large, northwest-trending thallium anomaly 1.5 by 3 miles (approx. 2.5 by 5 km) occurs in the granodioritic basement parallel to the regional structural trend. Thallium values are as high as 0.29 ppm. Within this extensive Tl anomaly, is a weaker coincident Ag, As, Se, and Te anomaly. A zone of moderate sericitic alteration is present within the anomaly outline. Copper oxide staining is locally present on joint surfaces. The geochemical trends suggest the most favorable prospecting ground may be outside the study area to the south.

3) Approximately 1.25 miles (2 km) east-southeast of the anomaly previously discussed in 2 above, is a parallel zone of high background thallium values with a single sample containing high background concentrations of As and Te. Surface exposures in the area are moderately

to strongly weathered, obscuring the apparently subtle alteration. This zone parallels the southern extension of the Nobel Canyon Fault, which may have served as a conduit structure.

4) The fine-grained granitic body (Tr_2i equivalent) in the SE¼, section 35, T9N, R20E (Plate 1), exhibits a strong Tl anomaly with weaker, sporadic Au, Se, and also Bi and Te values. Moderate to strong weathering has obscured alteration (and possibly mobilized trace elements), but 1-3% disseminated limonite after pyrite suggests the presence of pyrite in unweathered rock at depth. The coincidence of the geochemical anomaly with the younger rhyolite intrusion is suggestive of a Zaca-type system, but the apparent lack of stockwork development and volatile phase disruption is discouraging.

The other 'anomalous' sample sites indicated on Plate 3 bear no apparent relationship to any known geologically significant feature.

Summary

As demonstrated in the previous discussion of trace element distribution, the lithogeochemical sampling program has revealed spatial relationships consistent with the generalized hot springs epithermal model. Although the spectrum of mineralization styles in the study area is narrow and does not offer the geochemical contrast of a Guanajuato-type system to a Carlin-type system, the results indicate that similar controls on element mobility are in effect.

At the Morningstar Mine, roughly defined north-trending geochemical and alteration zoning are generally consistent with the model of Berger and Eimon (1982) (figure 6 p. 12). A footwall stockwork zone, anomalous in Au, As, Se, Bi, and Te, grades into a zone of jasperoid development that is anomalous in Ag, As, Au, Sb, Se, Bi, and Te. A zone of decreased silicification, hangwall to the jasperoid, is marked by a coincident Tl anomaly. The jasperoid zone is also marked by high base metal values. Plots of Cu, Pb, and Zn data from Benedict and others (1981) define a base metal anomaly (figures 11 - 13) coincident with the main Morningstar precious metal anomaly of this study (Plate 3). Similar zoning relationships are seen along other structures within the Monitor-Mogul District, although not as well developed or accompanied by significant base metal values as at the Morningstar.

Rhyolite-hosted mineralization at the Zaca Mine is characterized by a coincident Ag, Au, Sb, and Tl anomaly (see Plate 3). Thallium forms an extensive high background zone in the andesite intruded by the rhyolite. Other elements, including base metals (figures 11 - 13) are not found in anomalous concentrations associated with Zaca-type mineralization.

The localized alteration and mineralization, characteristic of the Silver Mountain District, is well documented by associated trace element anomalies. Productive vein structures are marked by limited Ag, As, Au, Sb, and Tl anomalies (Plate 3). Significant associated Se, Bi, or Te are absent. Base metal values are low and sporadic, being locally anomalous along precious metal-bearing structures.

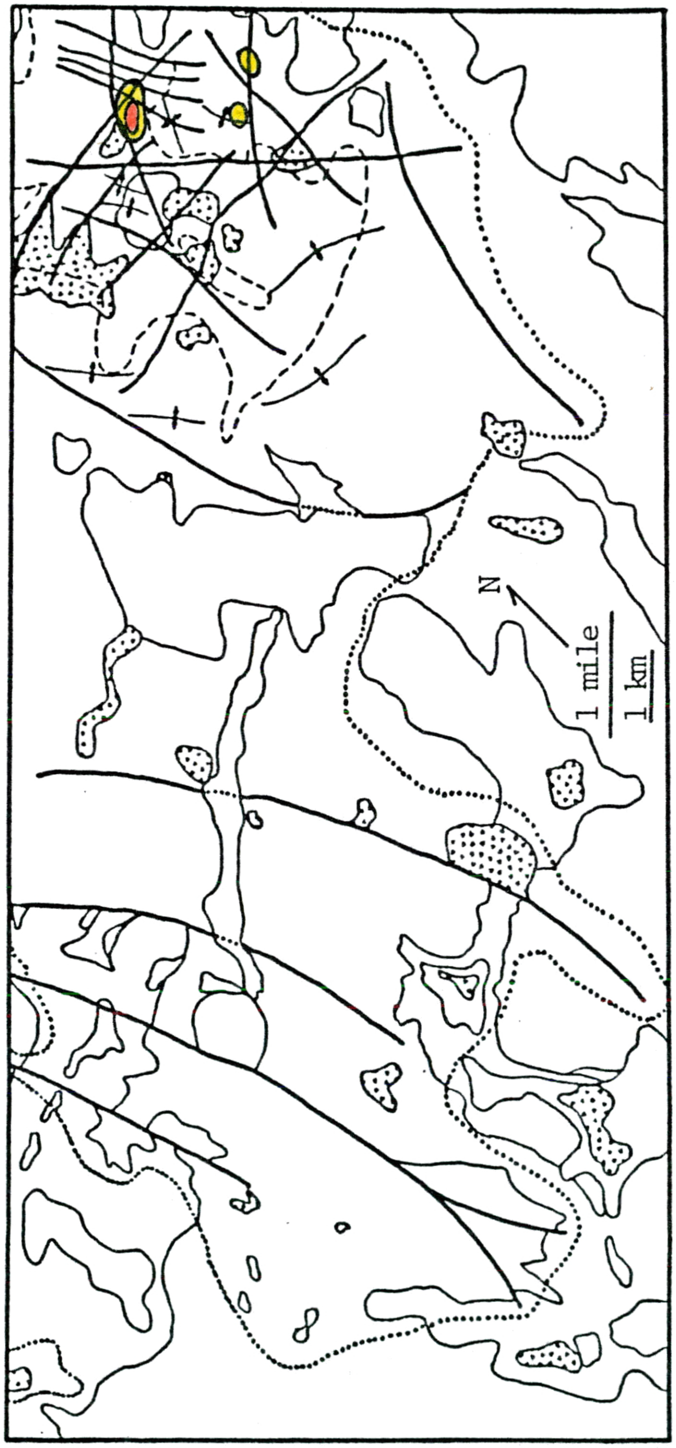


Figure 11) Copper in rock samples, east-central Alpine County, California. Semi-quantitative emission spectrographic data from Benedict and others (1981). Red > 500 ppm, yellow > 100 ppm.

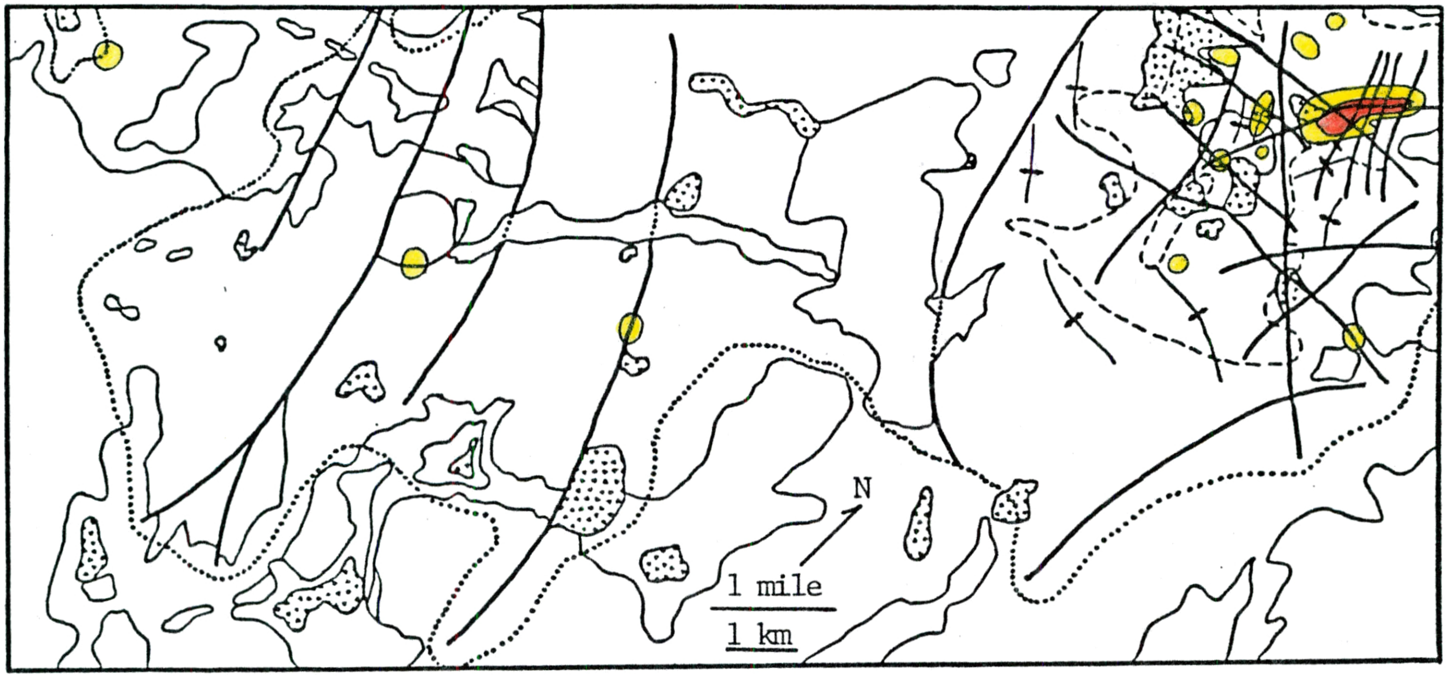


Figure 12) Lead in rock samples, east-central Alpine County, California. Semi-quantitative emission spectrographic data from Benedict and others (1981). Red > 500 ppm, yellow > 100 ppm.

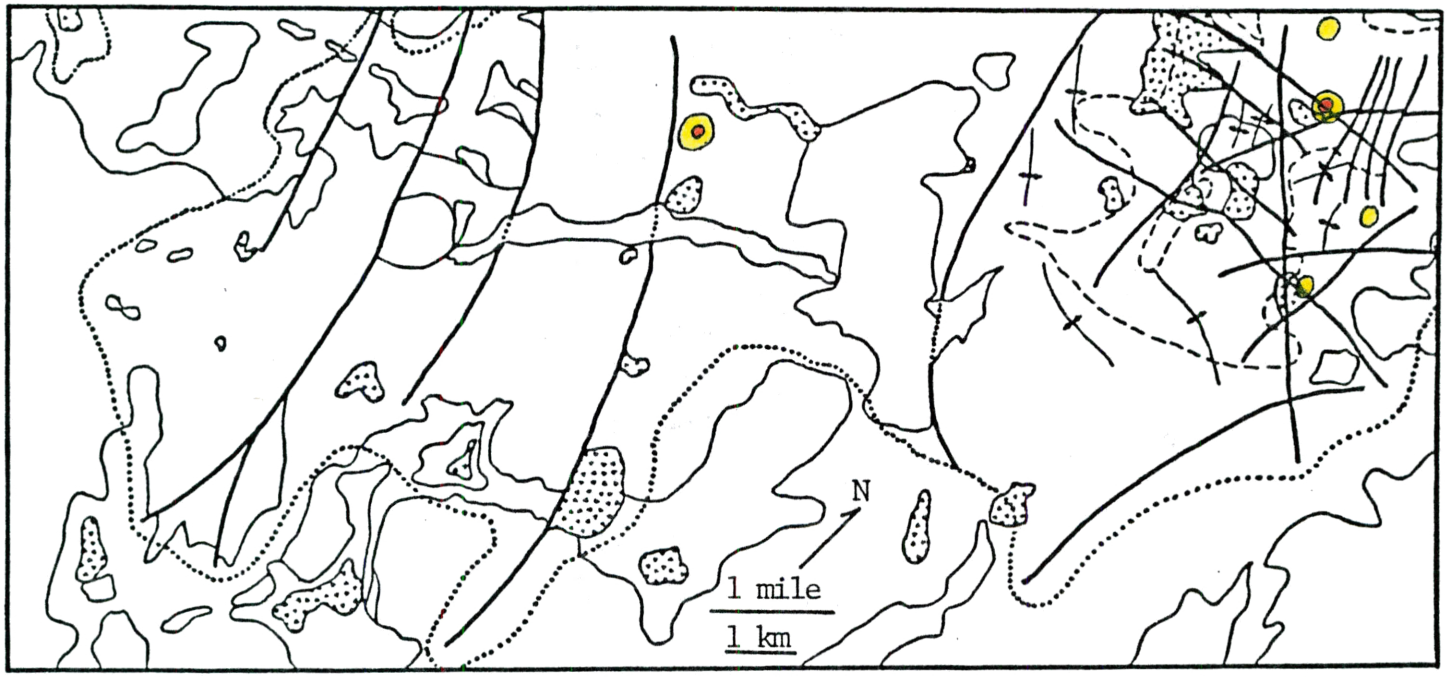


Figure 13) Zinc in rock samples, east-central Alpine County, California. Semi-quantitative emission spectrographic data from Benedict and others (1981). Red > 600 ppm, yellow > 200 ppm.

Based on the geochemical results the following generalizations can be made:

1) The structurally-controlled, andesite hosted mineralization in the Monitor-Mogul District appears to have formed in an environment of intense structural preparation and high heat-flow gradient. This is suggested by the rapid transition in alteration types, and also by the associated trace element zonation.

2) The rhyolite-hosted, Zaca-type mineralization in the Monitor-Mogul District is characterized by coincident anomalous Ag, Au, Sb, and Tl.

3) Selenium, As, Sb, and Tl, as well as the statistically unreliable Bi and Te, form broad, continuous anomalies and are good indicators for Morningstar-type mineralization.

4) Thallium is the only element which shows significant dispersion away from Zaca-type mineralization.

5) The limited structural deformation and well-contained, relatively uniform nature of alteration characteristic of the Silver Mountain District indicates formation in a much less intense hydrothermal environment. Mineralized structures in the district exhibit localized Ag, Au, As, Sb, and Tl anomalies. No vertical zonation is apparent from the results of this study.

The narrow spectrum of the geochemical environment present within the study area is further demonstrated by a correlation analysis performed on the trace element analytical data (Table 6). All elements,

Table 6. Linear Correlation Coefficients, Lithogeochemical Data, East-central Alpine County, California, Log_{10} Transformed Data (N = 266).

Element	Ag	As	Au	Bi	Sb	Se	Te	Tl
Ag	1.0							
As	0.52	1.00						
Au	0.51	0.40	1.00					
Bi	0.37	0.48	0.30	1.00				
Sb	0.53	0.73	0.50	0.50	1.00			
Se	0.30	0.46	0.42	0.55	0.65	1.00		
Te	0.27	0.36	0.30	0.56	0.46	0.65	1.00	
Tl	0.23	0.18	0.16	0.17	0.24	0.17	0.03	1.00

Degrees of Freedom = 264

All correlations significant at greater than 95% significance level of student's T test, except Tl Te which is less than 95%

except thallium, show a mutual, well-developed positive correlation. This suggests that similar factors are controlling transport and deposition. Certain elements do, however, show a stronger mutual correlation than others. Silver, arsenic, gold, and antimony form one interrelated group. Selenium, antimony, tellurium, and bismuth likewise form another. Thallium shows no well developed correlations and also exhibits a greater relative primary dispersion. As suggested by Ewers and Keays (1977), thallium may be subject to different transport and deposition controls.

Evaluation of the Sulfide-Selective Analytical Technique

It has been shown in the previous section that the primary distribution of the selected suite of trace elements has a direct spatial relationship to precious metal mineralization. Bearing this in mind, the utility of the 'MAGIC' extraction analytical method was evaluated, first by looking at possible advantages in target definition, and, secondly, by looking at the relative effectiveness when compared with the more commonly used commercially available analytical techniques.

Target Definition

The capabilities of the 'MAGIC' extraction analytical method give it three distinct advantages when applied to geochemical exploration. The cold bromate leach and organic extraction are sulfide selective and appropriately suited for evaluating sulfide-rich epigenetic systems. The variabilities induced by host-rock heterogeneities are minimized by an analytical method that is testing only the effects of the mineralizing event (Clark, 1983). The other benefit gained from the use of this technique is the enhanced lower detection limit capability. Lower detection limits have a number of significant advantages. In the absence of familiarity with specific threshold and anomaly levels, lower detection limits permit a more through sampling of the population range and the establishment of more realistic data parameters (i.e., background, threshold, anomaly, etc.). In certain instances, lower detection limits can permit anomaly contouring for elements of low crustal abundance such as Au, Se, and Tl.

Relative Effectiveness

Figures 14 through 17 represent the results of lithogeochemical sampling with emission spectrographic analyses for Ag, As, Sb, and Bi (Benedict and others, 1981). As can be seen when comparing these data to the 'MAGIC' extraction results (Plate 3), the emission spectrographic data, as contoured, are successful in duplicating the major anomalies. It should be noted, however, that the data have been contoured qualitatively and have not been subjected to a rigorous statistical evaluation. Also lacking in the emission spectrographic data is the ability to indicate the zoning trends revealed by the 'MAGIC' extraction, particularly with regards to Se and Tl. Table 7 represents

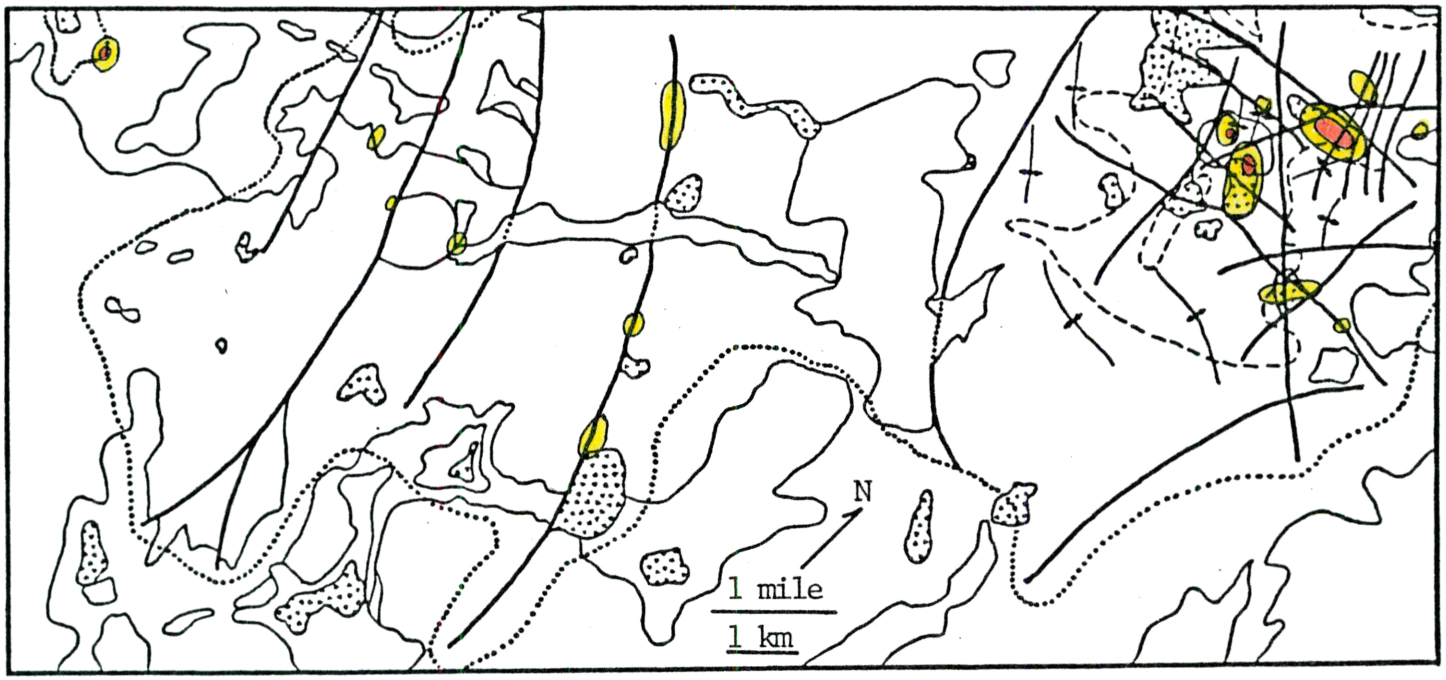


Figure 14) Silver in rock samples, east-central Alpine County, California. Semi-quantitative emission spectrographic data from Benedict and others (1981). Red > 10 ppm, yellow > 1 ppm.

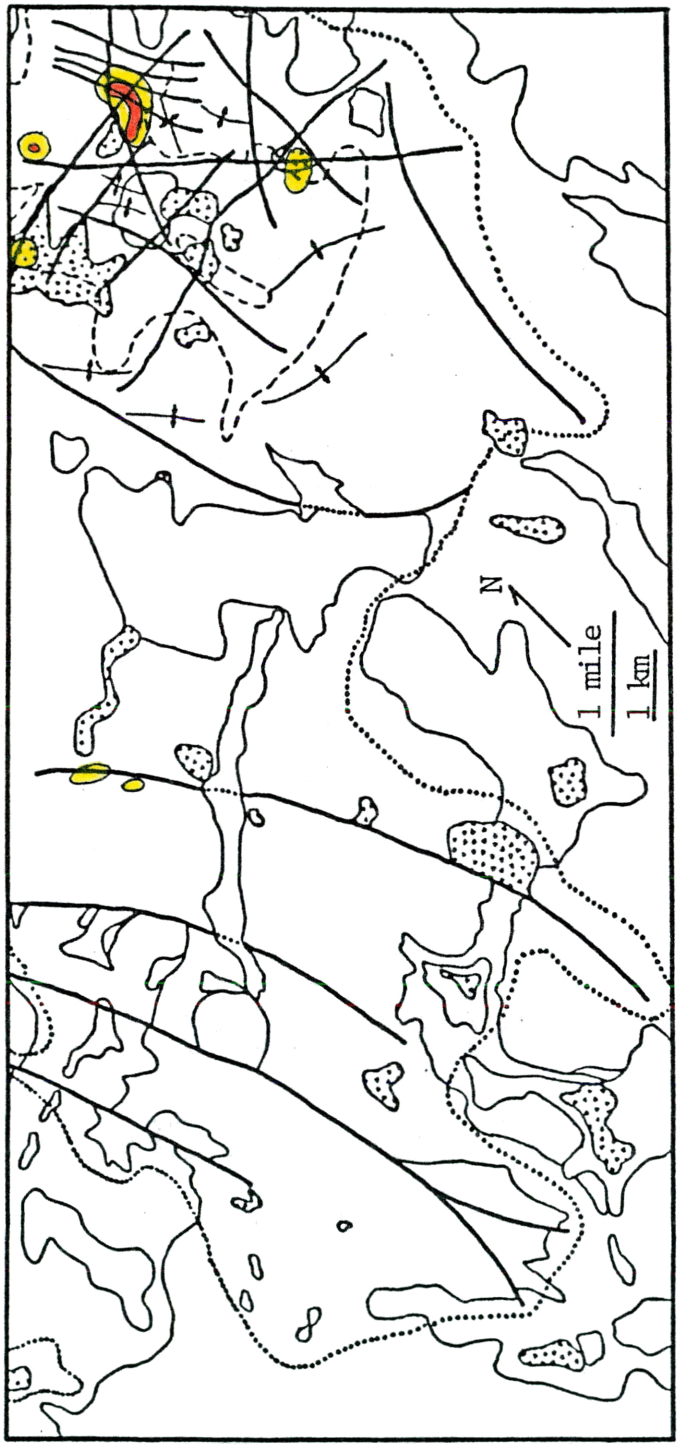


Figure 15) Arsenic in rock samples, east-central Alpine County, California. Semi-quantitative emission spectrographic data from Benedict and others (1981). Red>600 ppm, yellow>200 ppm.

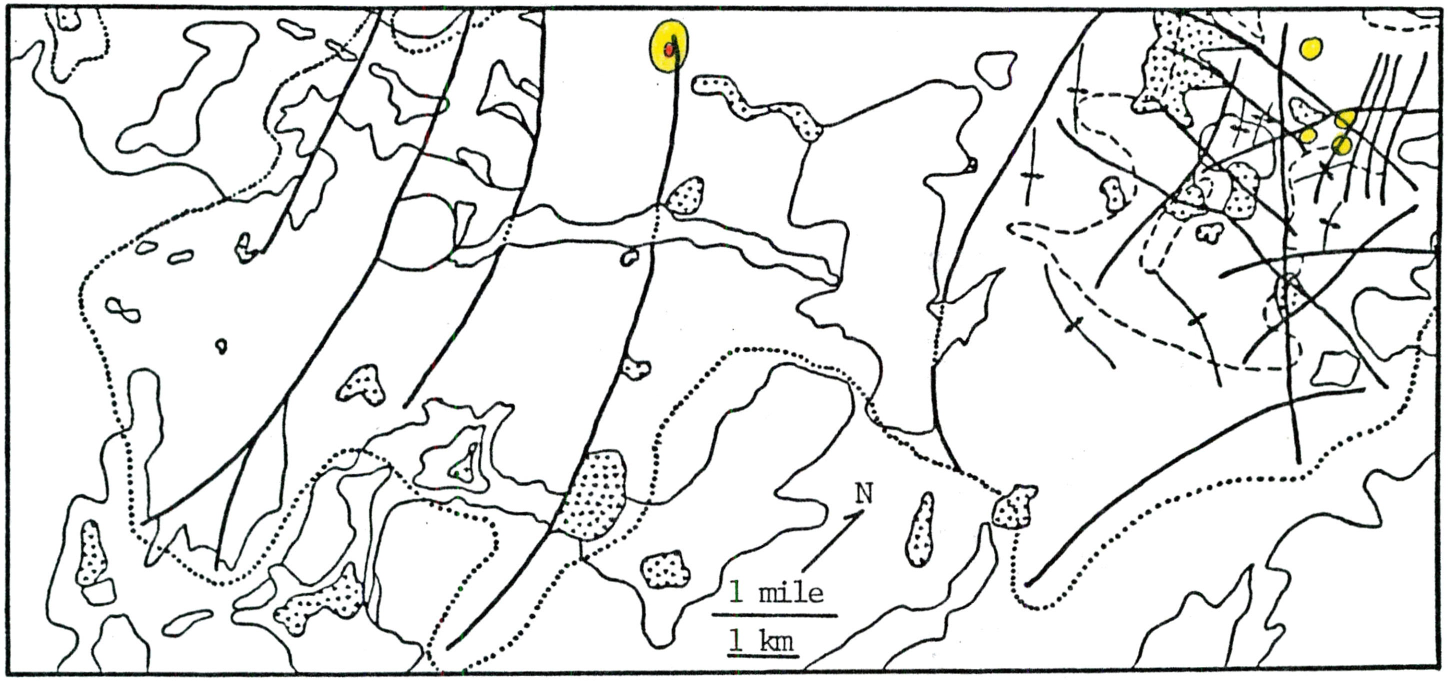


Figure 16) Antimony in rock samples, east-central Alpine County, California. Semi-quantitative emission spectrographic data from Benedict and others (1981). Red > 500 ppm, yellow > 100 ppm.

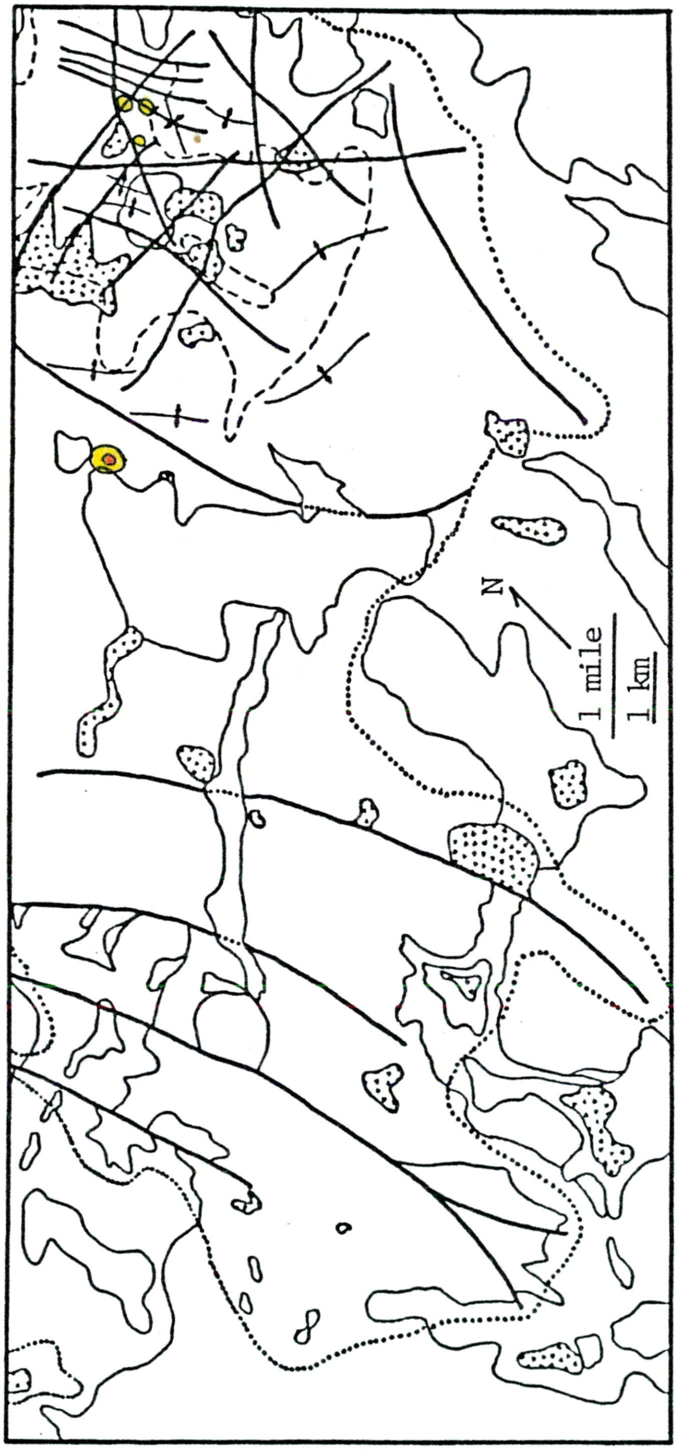


Figure 17) Bismuth in rock samples, east-central Alpine County, California. Semi-quantitative emission spectrographic data from Benedict and others (1981). Red > 50 ppm, yellow > 10 ppm.

Table 7. Comparative Capabilities of Commercial Geochemical Laboratories

(as of February, 1983)

	CMS, Inc. Salt Lake City, UT.		Barringer Resources Reno, NV.		Bondar-Clegg Lakewood, CO.		Rock Analysis, Inc.[2] Golden, CO.	
	Detection Limit	Cost	Detection Limit	Cost	Detection Limit	Cost	Detection Limit	Cost
Ag	0.3 ppm	3.50	0.1 ppm	3.00	0.2 ppm	1.90	.01 ppm	1.25
As	1.0 ppm	5.00	2.0 ppm	4.50	2.0 ppm	3.25	1.0 ppm	1.50
Au	0.02 ppm	3.50	0.02 ppm	3.00	0.005 ppm	6.00	0.003 ppm	4.00
Bi	1.0 ppm	5.00	2.0 ppm	2.00	1.0 ppm	2.50	0.018 ppm	4.25
Sb	1.0 ppm	5.00	1.0 ppm	4.50	2.0 ppm	4.00	0.5 ppm	1.50
Se	1.0 ppm	5.00	0.1 ppm	6.00	1.0 ppm	5.00	0.03 ppm	4.75
Te	1.0 ppm	5.00	1.0 ppm	6.00	0.2 ppm	5.25	0.015 ppm	4.50
Tl	0.2 ppm	8.00	0.1 ppm	6.00	0.5 ppm	5.25	0.018 ppm	4.75
Total Cost[1]	$40.00		$35.00		$33.15		$32.50[3] ($40.75)[4]	

1. Does not include sample preparations charges
2. Ag, As, Sb done by Flame AA, other elements by Flameless AA
3. Includes $6.00 digestion fee
4. Total price with lower limits for As and Sb by Flameless AA (.03 ppm As - $4.25, .024 ppm Sb - $4.00)

a partial compilation of commercial laboratory capabilities. The first three laboratories listed - Barringer, Bondar-Clegg, and CMS, are well established in the industry. Rock Analysis, Inc., on the other hand, is a recently established (1980) laboratory offering a version of the sulfide selective analytical technique developed by Clark (1981) which has been streamlined for commercial application. The procedure offered by Barringer, Bondar-Clegg, and CMS results in quantitative total analysis, reintroducing the problem of host-rock heterogeneity which can complicate data evaluation. Notice also the significantly higher detection limits (Table 7). In the cases of Bi, Se, Te, and Tl, these detection limits are significantly higher than the threshold values defined in this study. For Se and Tl a large portion of usable data would have been unobtainable. As for the emission spectrographic data, the detection limits for the other elements would have considerable influence on the statistical manipulation of the data and could result in unrealistic parameters.

RECOMMENDATIONS

While perhaps not used to its greatest advantage in a reconnaissance scale program, the potential target definition quality of the 'MAGIC' extraction analytical technique makes its application to epigenetic precious metals exploration worth consideration. The multi-element capability and low detection limits are a definite asset. The ability to delineate zoning in epithermal precious metal-bearing systems, where steep physiochemical gradients are thought responsible for ore deposition, is a key in successful exploration. As modeled by Berger and Eimon (1982), this zoning is expressed in rock alteration and mineralization, as well as in primary trace element dispersion. The results of this study indicate that this zoning can be geochemically exploited with success. It is suggested that the multi-element, sulfide specific technique would be most effectively applied during the follow-up phase of an exploration program. General targets identified using a more conventional or less detailed approach would benefit from the zoning definition potential of this method, particularly where three-dimensional data is available. By combining geochemical zoning with thorough alteration and structural analysis, target definition and the potential for sucess would be optimized.

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APPENDIX A: TRACE ELEMENT DATA

sample	Ag ppm	As ppm	Au ppm	Bi ppm	Sb ppm	Se ppm	Te ppm	Tl ppm
1)	.500000D-02	.900000D-01	.200000D-02	.160000D-01	.680000D-01	.700000D-02	.100000D-02	.120000D+00
2)	.600000D-02	.800000D-01	.200000D-02	.500000D-02	.520000D-01	.100000D-01	.700000D-02	.590000D-01
3)	.170000D-01	.900000D-01	.200000D-02	.100000D-01	.710000D-01	.150000D-01	.100000D-02	.180000D-01
4)	.510000D+00	.930000D+01	.200000D-02	.150000D+01	.370000D+00	.160000D+00	.200000D-01	.160000D+00
5)	.120000D+00	.600000D-01	.200000D-02	.500000D-02	.630000D-01	.210000D-01	.180000D-01	.120000D+00
6)	.100000D+00	.500000D-01	.600000D-02	.500000D-02	.540000D-01	.100000D-01	.400000D-02	.530000D-01
7)	.500000D-02	.600000D-01	.200000D-02	.120000D-01	.510000D-01	.900000D-02	.100000D-02	.300000D-01
8)	.180000D-01	.250000D+00	.200000D-02	.500000D-02	.730000D-01	.700000D-02	.400000D-02	.700000D-02
9)	.130000D+00	.270000D+00	.200000D-02	.190000D-01	.770000D-01	.200000D-02	.500000D-02	.190000D-01
10)	.810000D-01	.600000D-01	.200000D-02	.500000D-02	.480000D-01	.600000D-02	.600000D-02	.580000D-01
11)	.500000D-02	.450000D+00	.200000D-02	.100000D-01	.660000D-01	.500000D-02	.100000D-02	.200000D-02
12)	.110000D+00	.280000D+00	.200000D-02	.100000D-01	.910000D-01	.430000D-01	.100000D-02	.600000D-02
13)	.430000D-01	.220000D+00	.200000D-02	.100000D-01	.820000D-01	.800000D-02	.700000D-02	.110000D-01
14)	.180000D+00	.700000D-01	.700000D-02	.500000D-02	.550000D-01	.800000D-02	.500000D-02	.200000D-02
15)	.240000D+02	.150000D+02	.400000D-01	.350000D+00	.170000D+01	.360000D+01	.760000D+00	.130000D-01
16)	.270000D-01	.700000D-01	.200000D-02	.500000D-02	.750000D-01	.200000D-02	.300000D-02	.640000D-01
17)	.500000D-02	.400000D-01	.200000D-02	.500000D-02	.690000D-01	.100000D-01	.230000D-01	.460000D-01
18)	.130000D-01	.130000D+00	.740000D-01	.110000D-01	.500000D-01	.500000D-02	.800000D-02	.200000D-02
19)	.900000D-01	.240000D+00	.200000D-02	.500000D-02	.610000D-01	.900000D-02	.200000D-02	.170000D-01
20)	.200000D-02	.400000D-01	.200000D-02	.160000D-01	.490000D-01	.590000D-01	.260000D-01	.360000D-01
21)	.500000D-02	.100000D+00	.200000D-02	.100000D-01	.710000D-01	.200000D-02	.600000D-02	.120000D+00
22)	.760000D-01	.400000D-01	.200000D-02	.500000D-02	.800000D-01	.800000D-02	.300000D-02	.160000D+00
23)	.200000D-02	.100000D+00	.200000D-02	.120000D-01	.600000D-01	.130000D-01	.110000D-01	.170000D-01
24)	.230000D-01	.800000D-01	.200000D-02	.500000D-02	.760000D-01	.100000D-01	.100000D-02	.160000D+00
25)	.490000D-01	.210000D+03	.200000D-02	.300000D+00	.300000D+01	.900000D-01	.300000D-02	.270000D+00
26)	.270000D-01	.120000D+00	.200000D-02	.500000D-02	.600000D-01	.300000D-01	.910000D-01	.200000D-02
27)	.700000D-02	.100000D+00	.200000D-02	.500000D-02	.570000D-01	.170000D-01	.190000D-01	.230000D-01
28)	.530000D-01	.120000D+00	.200000D-02	.100000D-01	.410000D-01	.600000D-02	.500000D-02	.700000D-02
29)	.200000D-01	.350000D+00	.200000D-02	.100000D-01	.950000D-01	.500000D-02	.500000D-02	.200000D-02
30)	.170000D-01	.600000D-01	.200000D-02	.500000D-02	.650000D-01	.400000D-02	.100000D-02	.800000D-02
31)	.200000D-02	.900000D-01	.100000D-01	.450000D-01	.210000D+00	.180000D+01	.380000D+00	.500000D-02
32)	.100000D+00	.260000D+00	.200000D-02	.100000D-01	.700000D-01	.900000D-02	.110000D-01	.200000D-02
33)	.340000D-01	.120000D+00	.200000D-02	.280000D-01	.160000D+00	.220000D-01	.200000D-02	.200000D-01
34)	.110000D+00	.280000D+00	.200000D-02	.500000D-02	.810000D-01	.700000D-02	.240000D-01	.140000D-01
35)	.150000D-01	.500000D-01	.200000D-02	.500000D-02	.730000D-01	.600000D-02	.130000D-01	.290000D+00
36)	.310000D+01	.630000D+02	.160000D+00	.250000D-01	.460000D+01	.140000D-01	.130000D+00	.390000D-01
37)	.130000D-01	.150000D+00	.500000D-02	.100000D-01	.830000D-01	.120000D-01	.100000D-02	.100000D-01
38)	.130000D-01	.150000D+00	.320000D-01	.200000D-01	.250000D+00	.720000D+00	.110000D+00	.500000D-02
39)	.630000D-01	.640000D+00	.200000D-02	.120000D-01	.130000D+00	.110000D-01	.200000D-02	.200000D-02
40)	.110000D+01	.190000D+03	.290000D+00	.500000D-02	.110000D+02	.300000D-01	.140000D-01	.810000D-01
41)	.700000D-01	.460000D+00	.200000D-02	.130000D-01	.920000D-01	.100000D-01	.200000D-02	.200000D-02
42)	.130000D-01	.220000D+00	.200000D-02	.500000D-02	.680000D-01	.700000D-02	.200000D-01	.200000D-02
43)	.100000D-01	.500000D-01	.200000D-02	.500000D-02	.730000D-01	.400000D-02	.700000D-02	.200000D-02
44)	.200000D-02	.120000D+00	.350000D-01	.380000D-01	.210000D+00	.890000D+00	.420000D+00	.600000D-02
45)	.320000D-01	.700000D-01	.200000D-02	.100000D-01	.540000D-01	.120000D-01	.100000D-02	.110000D-01
46)	.152000D+00	.700000D-01	.200000D-02	.500000D-02	.900000D-01	.200000D-02	.400000D-02	.550000D-01
47)	.500000D-02	.500000D-01	.200000D-02	.100000D-01	.630000D-01	.370000D-01	.100000D-02	.500000D-02
48)	.350000D-01	.190000D+01	.200000D-02	.130000D-01	.520000D-01	.400000D-02	.100000D-02	.200000D-02
49)	.200000D-01	.200000D+00	.200000D-02	.500000D-02	.640000D-01	.200000D-02	.100000D-02	.200000D-02
50)	.360000D+00	.160000D+03	.370000D-01	.500000D-02	.710000D+01	.600000D-02	.400000D-02	.500000D-01
51)	.100000D+00	.470000D+00	.200000D-02	.170000D-01	.110000D+00	.300000D-01	.220000D-01	.700000D-02
52)	.270000D+00	.460000D+00	.320000D-01	.100000D-01	.310000D+00	.200000D-02	.400000D-02	.170000D-01
53)	.200000D+00	.320000D+00	.100000D-01	.140000D-01	.220000D+00	.180000D+00	.810000D-01	.600000D-02
54)	.110000D-01	.110000D+01	.200000D-02	.500000D-02	.170000D+00	.210000D-01	.400000D-02	.220000D-01
55)	.330000D-01	.120000D+00	.170000D-01	.140000D-01	.710000D-01	.800000D-02	.110000D-01	.530000D-01
56)	.890000D-01	.500000D-01	.200000D-02	.500000D-02	.670000D-01	.600000D-02	.100000D-02	.200000D-02
57)	.500000D-02	.700000D-01	.200000D-02	.500000D-02	.610000D-01	.700000D-02	.500000D-02	.200000D-02
58)	.190000D-01	.110000D+00	.200000D-02	.500000D-02	.690000D-01	.800000D-02	.100000D-02	.120000D-01

sample	Ag ppm	As ppm	Au ppm	Bi ppm	Sb ppm	Se ppm	Te ppm	Tl ppm
(59)	.200000D-02	.100000D+01	.200000D-02	.850000D-01	.820000D-01	.130000D-01	.100000D-02	.100000D-01
(60)	.150000D-01	.200000D+00	.200000D-02	.100000D-01	.950000D-01	.700000D-02	.500000D-02	.200000D-02
(61)	.500000D-02	.260000D+00	.200000D-02	.500000D-02	.880000D-01	.600000D-02	.200000D-02	.200000D-02
(62)	.900000D-01	.400000D-01	.130000D-01	.500000D-02	.500000D-01	.900000D-02	.700000D-02	.200000D-02
(63)	.930000D-01	.380000D+00	.200000D-02	.100000D-01	.660000D-01	.800000D-02	.140000D-01	.200000D-02
(64)	.340000D-01	.380000D+00	.200000D-02	.100000D-01	.100000D+00	.220000D-01	.300000D-02	.200000D-02
(65)	.470000D-01	.840000D+00	.200000D-02	.500000D-02	.110000D+00	.170000D-01	.100000D-02	.700000D-02
(66)	.150000D-01	.200000D+01	.200000D-02	.130000D-01	.930000D-01	.800000D-02	.230000D-01	.200000D-02
(67)	.410000D-01	.130000D+01	.200000D-02	.120000D-01	.740000D-01	.700000D-02	.100000D-02	.200000D-02
(68)	.140000D+00	.120000D+01	.110000D+00	.650000D-01	.850000D-01	.130000D-01	.400000D-02	.200000D-02
(69)	.600000D-01	.580000D+00	.200000D-02	.500000D-02	.650000D-01	.500000D-02	.100000D-02	.200000D-02
(70)	.200000D-02	.800000D-01	.200000D-02	.500000D-02	.410000D-01	.400000D-02	.120000D-01	.700000D-02
(71)	.170000D-01	.410000D+01	.200000D-02	.240000D-01	.100000D+00	.200000D-01	.700000D-02	.200000D-02
(72)	.840000D-01	.800000D-01	.700000D-02	.100000D-01	.660000D-01	.190000D-01	.100000D-02	.130000D-01
(73)	.920000D-01	.150000D+00	.200000D-02	.500000D-02	.710000D-01	.700000D-02	.180000D-01	.200000D-02
(74)	.500000D-02	.200000D-01	.200000D-02	.100000D-01	.750000D-01	.900000D-02	.230000D-01	.200000D-02
(75)	.650000D-01	.250000D+00	.200000D-02	.210000D-01	.700000D-01	.160000D+00	.100000D-02	.200000D-02
(76)	.200000D-02	.600000D-01	.990000D-01	.500000D-02	.980000D-01	.600000D-02	.130000D-01	.200000D-02
(77)	.450000D-01	.160000D+00	.130000D-01	.500000D-02	.940000D-01	.260000D-01	.100000D-02	.200000D-02
(78)	.630000D-01	.180000D+00	.200000D-02	.190000D-01	.160000D+00	.700000D-02	.300000D-02	.200000D-02
(79)	.130000D-01	.270000D+00	.200000D-02	.500000D-02	.640000D-01	.800000D-02	.200000D-02	.200000D-02
(80)	.130000D-01	.800000D-01	.200000D-02	.500000D-02	.730000D-01	.160000D-01	.140000D-01	.200000D-02
(81)	.130000D-01	.220000D+00	.200000D-02	.500000D-02	.410000D-01	.200000D-02	.100000D-02	.200000D-02
(82)	.670000D-01	.900000D-01	.200000D-02	.500000D-02	.660000D-01	.160000D-01	.200000D-02	.200000D-02
(83)	.500000D-02	.360000D+01	.200000D-02	.340000D+00	.210000D+00	.400000D-02	.900000D-02	.100000D-01
(84)	.440000D-01	.460000D+00	.700000D-02	.330000D-01	.140000D+00	.900000D-02	.100000D-02	.500000D-02
(85)	.500000D-02	.500000D-01	.200000D-02	.190000D-01	.510000D-01	.700000D-02	.300000D-02	.500000D-02
(86)	.800000D-01	.120000D+00	.200000D-02	.500000D-02	.630000D-01	.400000D-02	.100000D-02	.200000D-02
(87)	.410000D+00	.360000D+02	.510000D-01	.110000D+00	.400000D+00	.230000D+00	.700000D-02	.240000D-01
(88)	.460000D-01	.270000D+01	.500000D-02	.470000D-01	.330000D+00	.700000D-02	.200000D-02	.200000D-02
(89)	.480000D+00	.830000D+04	.200000D+00	.100000D-01	.900000D+02	.240000D+00	.820000D-01	.490000D-01
(90)	.380000D-01	.370000D+00	.200000D-02	.220000D-01	.130000D+00	.100000D-01	.500000D-02	.700000D-02
(91)	.500000D-02	.400000D-01	.200000D-02	.110000D-01	.790000D-01	.560000D-01	.500000D-02	.440000D-01
(92)	.400000D-01	.270000D+01	.200000D-02	.330000D-01	.150000D+00	.600000D-02	.400000D-02	.610000D-01
(93)	.500000D-02	.800000D-01	.200000D-02	.120000D-01	.490000D-01	.170000D-01	.180000D-01	.900000D-02
(94)	.500000D-02	.400000D-01	.200000D-02	.500000D-02	.700000D-01	.700000D-02	.100000D-02	.270000D-01
(95)	.300000D-01	.930000D+00	.700000D-02	.100000D-01	.180000D+00	.100000D-01	.700000D-02	.110000D-01
(96)	.800000D-01	.180000D+00	.500000D-02	.170000D-01	.880000D-01	.900000D-02	.100000D-01	.200000D-02
(97)	.170000D-01	.900000D-01	.200000D-02	.500000D-02	.630000D-01	.100000D-01	.800000D-02	.200000D-02
(98)	.120000D-01	.500000D+00	.200000D-02	.180000D-01	.160000D+00	.100000D-01	.100000D-02	.410000D-01
(99)	.250000D-01	.500000D-01	.500000D-02	.500000D-02	.700000D-01	.110000D-01	.400000D-02	.900000D-02
(100)	.100000D-01	.130000D+00	.200000D-02	.120000D-01	.810000D-01	.110000D-01	.800000D-02	.170000D-01
(101)	.100000D+00	.450000D+00	.200000D-02	.140000D-01	.590000D-01	.120000D-01	.100000D-02	.600000D-02
(102)	.200000D-02	.190000D+00	.200000D-02	.100000D-01	.520000D-01	.360000D-01	.190000D-01	.310000D-01
(103)	.200000D-02	.900000D-01	.700000D-02	.250000D-01	.100000D+00	.220000D+01	.140000D+00	.200000D-02
(104)	.200000D-02	.500000D-01	.200000D-02	.500000D-02	.680000D-01	.100000D-01	.100000D-02	.950000D-01
(105)	.500000D-02	.800000D-01	.380000D-01	.420000D-01	.310000D+00	.500000D+00	.240000D+00	.800000D-02
(106)	.110000D-01	.290000D+00	.200000D-02	.260000D-01	.740000D-01	.150000D-01	.500000D-02	.440000D-01
(107)	.500000D-02	.140000D+00	.200000D-02	.250000D-01	.610000D-01	.500000D-02	.700000D-02	.310000D-01
(108)	.190000D-01	.190000D+00	.200000D-02	.500000D-02	.710000D-01	.500000D-02	.100000D-02	.500000D-02
(109)	.350000D-01	.120000D+00	.200000D-02	.600000D+00	.450000D+00	.190000D+01	.280000D+00	.860000D-01
(110)	.970000D-01	.321000D+03	.850000D-01	.500000D-02	.140000D+02	.290000D+01	.120000D-01	.470000D-01
(111)	.690000D-01	.270000D+01	.200000D-02	.120000D-01	.110000D+01	.890000D-01	.140000D-01	.600000D-02
(112)	.760000D-01	.330000D+00	.200000D-02	.780000D-01	.210000D+00	.170000D-01	.830000D-01	.190000D-01
(113)	.200000D-02	.400000D-01	.200000D-02	.500000D-02	.590000D-01	.100000D+00	.100000D-02	.140000D-01
(114)	.200000D-02	.170000D+01	.470000D-01	.100000D-01	.110000D+01	.110000D+00	.700000D-02	.600000D-02
(115)	.730000D-01	.220000D+01	.200000D-02	.670000D-01	.260000D+01	.400000D-02	.940000D-01	.600000D-02
(116)	.100000D+00	.120000D+01	.240000D+00	.130000D+00	.190000D+01	.620000D+00	.570000D+00	.140000D-01
(117)	.200000D-02	.800000D-01	.360000D-01	.120000D+00	.210000D+00	.640000D+00	.220000D+00	.500000D-02
(118)	.300000D-01	.250000D+02	.200000D-02	.290000D-01	.800000D+00	.130000D-01	.100000D-02	.170000D+00

sample	Ag ppm	As ppm	Au ppm	Bi ppm	Sb ppm	Se ppm	Te ppm	Tl ppm
(119)	.270000D+00	.690000D+01	.160000D-01	.120000D+01	.160000D+01	.500000D-02	.100000D-02	.310000D-01
(120)	.310000D-01	.260000D+00	.170000D-01	.550000D-01	.240000D+00	.130000D+01	.160000D-01	.120000D+00
(121)	.180000D-01	.340000D+00	.200000D-02	.840000D+00	.130000D+00	.520000D-01	.660000D-01	.600000D-02
(122)	.330000D+00	.180000D+01	.200000D+00	.920000D+00	.480000D+00	.290000D+00	.810000D-01	.110000D+00
(123)	.110000D-01	.110000D+04	.200000D-02	.100000D-01	.180000D+02	.540000D+01	.500000D-02	.110000D-01
(124)	.500000D-02	.130000D+01	.700000D-02	.100000D-01	.710000D+00	.140000D+01	.280000D+00	.200000D-02
(125)	.500000D-02	.186000D+03	.200000D-02	.200000D-01	.630000D+01	.430000D+00	.900000D-02	.200000D-02
(126)	.300000D-01	.140000D+01	.200000D-02	.140000D-01	.150000D+00	.400000D-02	.300000D-02	.200000D-02
(127)	.200000D-01	.220000D+00	.200000D-02	.500000D-02	.500000D-01	.400000D-02	.200000D-02	.700000D-02
(128)	.520000D-01	.510000D+00	.200000D-02	.500000D-02	.730000D-01	.100000D-01	.180000D-01	.270000D-01
(129)	.460000D-01	.740000D+02	.200000D-02	.800000D-01	.100000D+01	.180000D+01	.340000D+00	.110000D+00
(130)	.650000D-01	.370000D+00	.200000D-02	.150000D-01	.670000D-01	.400000D-01	.170000D-01	.930000D-01
(131)	.260000D+00	.210000D+01	.200000D-02	.500000D-02	.260000D+01	.260000D-01	.500000D-02	.140000D+00
(132)	.780000D-01	.160000D+00	.200000D-02	.270000D-01	.310000D+00	.360000D+00	.140000D-01	.150000D-01
(133)	.620000D+00	.530000D+00	.810000D-01	.210000D-01	.480000D+00	.320000D+00	.100000D-02	.860000D-01
(134)	.230000D+00	.600000D-01	.500000D-02	.200000D-01	.290000D+00	.500000D-02	.300000D-02	.570000D-01
(135)	.160000D+00	.490000D+01	.200000D-02	.750000D-01	.130000D+00	.800000D-02	.120000D+00	.480000D-01
(136)	.500000D-01	.200000D+00	.200000D-02	.500000D-02	.940000D-01	.100000D-01	.120000D-01	.700000D-02
(137)	.180000D-01	.800000D-01	.200000D-02	.500000D-02	.600000D-01	.600000D-02	.130000D-01	.510000D-01
(138)	.320000D-01	.110000D+00	.140000D-01	.500000D-02	.980000D-01	.100000D-01	.100000D-02	.760000D-01
(139)	.140000D+00	.170000D+01	.200000D-02	.450000D+00	.460000D+00	.180000D+00	.490000D-01	.270000D-01
(140)	.500000D-01	.180000D+00	.200000D-02	.500000D-02	.510000D-01	.800000D-02	.160000D-01	.910000D-01
(141)	.220000D-01	.800000D-01	.900000D-02	.500000D-02	.670000D-01	.600000D-02	.140000D-01	.850000D-01
(142)	.240000D+01	.200000D+00	.710000D-01	.500000D-02	.480000D+00	.900000D-02	.200000D-02	.750000D-01
(143)	.720000D+00	.750000D+01	.290000D+00	.500000D-02	.360000D+01	.170000D+00	.500000D-02	.820000D-01
(144)	.500000D-02	.310000D+00	.470000D-01	.500000D-02	.120000D+01	.600000D-02	.600000D-02	.580000D-01
(145)	.400000D-01	.180000D+00	.200000D-02	.500000D-02	.180000D+00	.600000D-02	.100000D-02	.680000D-01
(146)	.350000D+00	.700000D-01	.240000D-01	.500000D-02	.260000D+00	.900000D-02	.600000D-02	.680000D-01
(147)	.430000D+00	.590000D+01	.800000D-02	.350000D-01	.200000D+01	.220000D+00	.100000D+00	.460000D-01
(148)	.340000D-01	.470000D+00	.700000D-02	.500000D-02	.190000D+01	.140000D+00	.600000D-02	.160000D-01
(149)	.490000D-01	.190000D+00	.200000D-02	.180000D-01	.640000D+00	.680000D-01	.120000D-01	.200000D-02
(150)	.100000D+00	.300000D+02	.200000D-02	.230000D+02	.500000D+02	.140000D+01	.140000D+00	.350000D-01
(151)	.110000D-01	.440000D+00	.200000D-02	.100000D-01	.200000D+00	.720000D+00	.160000D+00	.120000D+00
(152)	.200000D-02	.900000D-01	.200000D-02	.120000D-01	.960000D-01	.150000D+00	.710000D-01	.600000D-02
(153)	.190000D-01	.500000D-01	.200000D-02	.500000D-02	.590000D-01	.100000D-01	.500000D-02	.600000D-02
(154)	.200000D-02	.800000D-01	.200000D-02	.100000D-01	.630000D-01	.240000D-01	.300000D-02	.280000D-01
(155)	.820000D-01	.100000D+00	.200000D-02	.500000D-02	.480000D-01	.500000D-02	.140000D-01	.200000D-02
(156)	.200000D-02	.100000D+00	.680000D-01	.220000D-01	.110000D+00	.300000D-02	.200000D-02	.200000D-02
(157)	.500000D-02	.150000D+00	.200000D-02	.100000D-01	.120000D+00	.200000D-02	.600000D-02	.200000D-02
(158)	.390000D-01	.160000D+00	.200000D-02	.450000D-01	.740000D-01	.400000D-02	.300000D-02	.100000D-01
(159)	.840000D-01	.500000D-01	.200000D-02	.100000D-01	.510000D-01	.900000D-02	.500000D-02	.200000D-02
(160)	.800000D-01	.800000D-01	.390000D-01	.500000D-02	.610000D-01	.200000D-02	.400000D-02	.200000D-02
(161)	.500000D-02	.140000D+00	.200000D-02	.100000D-01	.640000D-01	.500000D-01	.230000D-01	.800000D-02
(162)	.500000D-02	.420000D+00	.200000D-02	.500000D-02	.780000D-01	.800000D-02	.100000D-02	.200000D-02
(163)	.170000D-01	.500000D-01	.200000D-02	.500000D-02	.910000D-01	.860000D-01	.900000D-02	.580000D-01
(164)	.720000D-01	.130000D+01	.900000D-02	.500000D-02	.340000D+01	.710000D-01	.900000D-02	.190000D-01
(165)	.130000D-01	.800000D-01	.200000D-02	.500000D-02	.810000D-01	.150000D-01	.100000D-02	.900000D-02
(166)	.500000D-02	.110000D+00	.200000D-02	.500000D-02	.690000D-01	.600000D-02	.400000D-02	.200000D-02
(167)	.100000D+00	.890000D+01	.200000D-02	.190000D+02	.180000D+02	.170000D+01	.150000D+00	.100000D+00
(168)	.200000D-02	.500000D-01	.200000D-02	.500000D-02	.130000D+00	.500000D-02	.200000D-02	.140000D-01
(169)	.500000D-02	.620000D+00	.200000D-02	.500000D-02	.110000D+01	.590000D+00	.140000D-01	.230000D-01
(170)	.500000D-02	.690000D+00	.200000D-02	.500000D-02	.900000D-01	.880000D-01	.300000D-02	.200000D-02
(171)	.200000D-02	.110000D+00	.420000D-01	.350000D+00	.210000D+01	.140000D+01	.440000D+00	.100000D-01
(172)	.110000D+00	.230000D+00	.200000D-02	.300000D-01	.520000D-01	.220000D-01	.100000D-01	.140000D-01
(173)	.500000D-02	.210000D+00	.790000D-01	.500000D-02	.790000D-01	.400000D-02	.100000D-02	.200000D-02
(174)	.220000D+00	.800000D-01	.200000D-02	.500000D-02	.900000D-01	.500000D-02	.100000D-02	.430000D-01
(175)	.210000D+00	.310000D+02	.850000D-01	.200000D+00	.340000D+02	.330000D+01	.540000D-01	.370000D-01
(176)	.100000D-01	.120000D+00	.200000D-02	.100000D-01	.300000D+02	.450000D+00	.200000D-02	.900000D-02
(177)	.150000D+00	.620000D+01	.200000D-02	.850000D+00	.420000D+02	.490000D+00	.190000D+00	.170000D-01
(178)	.700000D-01	.590000D+01	.200000D-02	.500000D-02	.560000D+02	.130000D+00	.100000D-02	.140000D+00

sample	Ag ppm	As ppm	Au ppm	Bi ppm	Sb ppm	Se ppm	Te ppm	Tl ppm
(179)	.510000D-01	.180000D+00	.200000D-02	.100000D-01	.210000D+02	.100000D+00	.400000D-02	.180000D-01
(180)	.410000D+01	.150000D+02	.200000D-02	.320000D+01	.740000D+02	.890000D+00	.110000D+01	.100000D-01
(181)	.630000D-01	.240000D+02	.470000D-01	.170000D-01	.680000D+02	.600000D+00	.690000D-01	.500000D-02
(182)	.320000D+01	.896000D+03	.460000D-01	.600000D+00	.395000D+03	.110000D+02	.120000D+02	.150000D-01
(183)	.570000D+02	.460000D+03	.290000D+01	.350000D+01	.260000D+03	.990000D+01	.170000D+01	.140000D-01
(184)	.100000D+02	.160000D+02	.180000D+00	.450000D+01	.110000D+03	.850000D+01	.520000D+01	.200000D-02
(185)	.940000D+02	.243000D+04	.390000D+01	.210000D+02	.170000D+03	.290000D+02	.140000D+02	.120000D+00
(186)	.200000D-02	.200000D+00	.200000D-02	.500000D-02	.630000D-01	.120000D-01	.900000D-02	.200000D-02
(187)	.640000D+00	.120000D+01	.600000D-02	.460000D+00	.110000D+01	.660000D+00	.180000D-01	.350000D+00
(188)	.140000D+01	.220000D+01	.200000D-02	.120000D+00	.430000D+02	.640000D+00	.220000D+00	.120000D-01
(189)	.500000D-02	.800000D-01	.200000D-02	.500000D-02	.200000D+00	.140000D-01	.700000D-02	.350000D-01
(190)	.130000D-01	.110000D+00	.200000D-02	.140000D-01	.110000D+00	.600000D-02	.600000D-02	.900000D-02
(191)	.410000D-01	.500000D-01	.200000D-02	.160000D-01	.150000D+00	.400000D-02	.500000D-02	.220000D-01
(192)	.250000D+01	.780000D+01	.120000D+00	.820000D+00	.100000D+00	.160000D+01	.240000D+00	.150000D+00
(193)	.840000D-01	.150000D+01	.200000D-02	.430000D-01	.430000D+02	.440000D+00	.140000D+00	.380000D-01
(194)	.940000D+02	.220000D+00	.700000D+01	.100000D-01	.510000D+02	.970000D+00	.100000D-02	.610000D-01
(195)	.220000D+00	.320000D+00	.560000D-01	.100000D-01	.110000D+02	.160000D+01	.400000D-02	.700000D-02
(196)	.710000D-01	.230000D+02	.200000D-02	.130000D+00	.190000D+02	.140000D+00	.970000D-01	.500000D-02
(197)	.170000D+00	.700000D-01	.310000D-01	.170000D+00	.890000D-01	.230000D+00	.700000D-02	.200000D-02
(198)	.870000D-01	.150000D+00	.200000D-02	.500000D-02	.750000D-01	.390000D+01	.160000D+01	.200000D-02
(199)	.200000D-02	.800000D-01	.280000D-01	.400000D+00	.190000D+01	.790000D+00	.180000D+00	.500000D-02
(200)	.450000D+00	.800000D-01	.300000D-01	.500000D-02	.540000D+01	.380000D+00	.100000D-02	.780000D-01
(201)	.860000D-01	.130000D+00	.700000D-02	.500000D-02	.650000D+00	.420000D+00	.900000D-02	.740000D-01
(202)	.100000D+00	.360000D+00	.200000D-02	.100000D-01	.900000D+00	.200000D-02	.400000D-02	.200000D-02
(203)	.130000D+00	.530000D+01	.200000D-02	.500000D-02	.210000D+01	.550000D-01	.100000D-01	.200000D-02
(204)	.770000D-01	.120000D+01	.700000D-02	.200000D+00	.340000D+01	.580000D+00	.180000D+00	.140000D-01
(205)	.210000D-01	.600000D+00	.200000D-02	.500000D-02	.810000D-01	.160000D-01	.100000D-02	.200000D-02
(206)	.110000D-01	.900000D-01	.200000D-02	.220000D-01	.930000D-01	.900000D-02	.100000D-02	.110000D-01
(207)	.910000D-01	.210000D+00	.200000D-02	.100000D-01	.530000D-01	.400000D-02	.640000D-01	.200000D-02
(208)	.220000D-01	.450000D+00	.200000D-02	.500000D-02	.490000D-01	.920000D-01	.200000D-02	.500000D-02
(209)	.240000D-01	.180000D+00	.200000D-02	.500000D-02	.660000D-01	.400000D-02	.120000D-01	.200000D-02
(210)	.120000D+00	.240000D+00	.200000D-02	.150000D-01	.770000D-01	.600000D-02	.200000D-02	.200000D-02
(211)	.230000D-01	.390000D+01	.200000D-01	.100000D-01	.110000D+00	.300000D-02	.500000D-02	.500000D-02
(212)	.120000D+00	.230000D+00	.500000D-02	.100000D-01	.390000D+01	.240000D+01	.150000D+00	.700000D-02
(213)	.130000D+00	.160000D+01	.200000D-02	.200000D-01	.300000D+00	.210000D+00	.310000D-01	.500000D-02
(214)	.210000D-01	.600000D-01	.200000D-02	.500000D-02	.670000D-01	.800000D-02	.800000D-02	.600000D-02
(215)	.580000D-01	.170000D+01	.500000D-02	.500000D-02	.840000D-01	.240000D-01	.550000D-01	.200000D-02
(216)	.100000D-01	.700000D+00	.200000D-02	.110000D-01	.710000D-01	.800000D-02	.100000D-02	.810000D-01
(217)	.200000D-02	.500000D-01	.190000D-01	.340000D-01	.180000D+01	.230000D+01	.190000D+00	.100000D-01
(218)	.500000D-02	.140000D+00	.200000D-02	.140000D-01	.830000D-01	.190000D-01	.200000D-02	.100000D+00
(219)	.240000D-01	.800000D-01	.200000D-02	.500000D-02	.620000D-01	.140000D-01	.120000D-01	.150000D+00
(220)	.470000D-01	.900000D-01	.200000D-02	.130000D-01	.130000D+00	.800000D-02	.100000D-02	.170000D+00
(221)	.570000D-01	.500000D-01	.200000D-02	.500000D-02	.610000D-01	.200000D-02	.480000D-01	.200000D-02
(222)	.500000D-01	.340000D+00	.200000D-02	.240000D-01	.850000D-01	.400000D-02	.700000D-02	.700000D-02
(223)	.180000D+00	.700000D-01	.150000D-01	.500000D-02	.100000D+00	.100000D-01	.100000D-01	.170000D-01
(224)	.490000D+00	.100000D+03	.380000D-01	.260000D+00	.740000D+02	.410000D-01	.800000D-02	.690000D-01
(225)	.360000D-01	.240000D+00	.200000D-02	.100000D-01	.630000D-01	.500000D-02	.400000D-02	.200000D-02
(226)	.380000D-01	.430000D+00	.200000D-02	.100000D-01	.240000D+00	.800000D-02	.100000D-02	.370000D-01
(227)	.360000D-01	.500000D+00	.200000D-02	.500000D-02	.910000D-01	.800000D-02	.100000D-02	.900000D-02
(228)	.770000D-01	.400000D-01	.200000D-02	.100000D-01	.700000D-01	.800000D-02	.800000D-02	.200000D-02
(229)	.530000D-01	.100000D+01	.200000D-02	.500000D-02	.310000D+00	.190000D-01	.200000D-02	.241000D+00
(230)	.180000D-01	.170000D+00	.200000D-02	.100000D-01	.590000D-01	.200000D-02	.800000D-02	.200000D-02
(231)	.390000D-01	.360000D+00	.200000D-02	.150000D+00	.190000D+01	.800000D-02	.900000D-02	.200000D-02
(232)	.550000D-01	.900000D-01	.200000D-02	.500000D-02	.840000D-01	.150000D-01	.400000D-02	.230000D-01
(233)	.210000D+00	.200000D+01	.100000D-01	.500000D-02	.410000D+01	.300000D-02	.190000D-01	.400000D-01
(234)	.350000D-01	.430000D+00	.500000D-02	.150000D-01	.730000D-01	.600000D-02	.200000D-02	.200000D-02
(235)	.830000D-01	.140000D+00	.200000D-02	.160000D-01	.690000D-01	.230000D-01	.370000D-01	.200000D-02
(236)	.350000D-01	.710000D+00	.200000D-02	.140000D-01	.110000D+00	.800000D-02	.100000D-02	.200000D-02
(237)	.160000D+01	.240000D+01	.750000D-01	.340000D-01	.540000D+00	.180000D+00	.600000D-02	.940000D-01
(238)	.280000D+00	.210000D+01	.210000D-01	.900000D-02	.410000D+00	.800000D-02	.400000D-02	.500000D-02

sample	Ag ppm	As ppm	Au ppm	Bi ppm	Sb ppm	Se ppm	Te ppm	Tl ppm
(239)	.350000D-01	.190000D+01	.200000D-02	.130000D-01	.400000D+00	.110000D-01	.400000D-02	.700000D-02
(240)	.270000D+00	.270000D+00	.510000D-01	.190000D-01	.230000D+00	.150000D-01	.700000D-02	.300000D-01
(241)	.100000D+01	.190000D+03	.720000D-01	.130000D+00	.430000D+02	.230000D+00	.190000D-01	.630000D-01
(242)	.180000D-01	.100000D+01	.200000D-02	.500000D-02	.300000D+00	.700000D-02	.130000D-01	.600000D-02
(243)	.200000D-02	.480000D+00	.200000D-02	.500000D-02	.270000D+00	.100000D-01	.700000D-02	.200000D-02
(244)	.900000D-02	.110000D+00	.200000D-02	.500000D-02	.850000D-01	.140000D-01	.200000D-02	.200000D-02
(245)	.150000D-01	.140000D+00	.200000D-02	.100000D-01	.830000D-01	.300000D-01	.800000D-02	.150000D-01
(246)	.350000D-01	.960000D+00	.200000D-02	.100000D-01	.290000D+00	.900000D-02	.300000D-02	.200000D-02
(247)	.360000D+00	.140000D+01	.200000D-02	.500000D-02	.860000D+00	.110000D-01	.400000D-02	.400000D-01
(248)	.620000D-01	.600000D-01	.200000D+00	.500000D-02	.100000D+01	.230000D-01	.200000D-02	.200000D-02
(249)	.190000D-01	.270000D+00	.200000D-02	.120000D-01	.910000D-01	.210000D-01	.130000D-01	.800000D-02
(250)	.200000D-02	.170000D+00	.200000D-02	.500000D-02	.700000D-01	.900000D-02	.100000D-02	.500000D-02
(251)	.780000D-01	.180000D+00	.200000D-02	.500000D-02	.730000D-01	.130000D-01	.900000D-02	.500000D-02
(252)	.650000D-01	.300000D+00	.200000D-02	.500000D-02	.800000D-01	.500000D-02	.500000D-02	.300000D-01
(253)	.200000D-02	.100000D+00	.200000D-02	.100000D-01	.750000D-01	.900000D-02	.130000D-01	.530000D-01
(254)	.360000D-01	.900000D-01	.500000D-02	.160000D-01	.840000D-01	.700000D-02	.100000D-01	.500000D-02
(255)	.120000D+00	.400000D-01	.200000D-02	.110000D-01	.790000D-01	.400000D-02	.100000D-02	.220000D-01
(256)	.130000D+01	.200000D+03	.480000D-01	.100000D-01	.130000D+03	.910000D+00	.150000D-01	.800000D-02
(257)	.120000D+00	.920000D+00	.200000D-02	.130000D-01	.710000D+00	.140000D+00	.150000D-01	.400000D-01
(258)	.500000D-01	.180000D+01	.200000D-02	.300000D-01	.680000D+01	.190000D+01	.240000D+01	.200000D-02
(259)	.280000D+01	.130000D+02	.120000D+00	.110000D-01	.140000D+02	.200000D-02	.700000D-02	.200000D+00
(260)	.260000D+00	.840000D+00	.500000D-02	.140000D-01	.310000D+00	.800000D-02	.100000D-01	.550000D-01
(261)	.130000D+00	.200000D+01	.200000D-02	.500000D-02	.790000D+01	.150000D-01	.160000D-01	.200000D-02
(262)	.100000D-01	.100000D+00	.200000D-02	.500000D-02	.800000D+00	.400000D-02	.900000D-02	.630000D-01
(263)	.150000D+00	.700000D+00	.200000D-02	.200000D-01	.510000D-01	.900000D-02	.700000D-02	.200000D-02
(264)	.250000D-01	.300000D+00	.200000D-02	.500000D-02	.680000D-01	.130000D-01	.800000D-02	.600000D-02
(265)	.200000D-02	.600000D-01	.200000D-02	.500000D-02	.650000D-01	.700000D-02	.400000D-02	.700000D-02
(266)	.500000D-02	.130000D+00	.200000D-02	.500000D-02	.630000D-01	.800000D-02	.100000D-02	.900000D-02

APPENDIX B: BASIC STATISTICAL PROCESSING RESULTS ($\log_{10}$ data)

TRANSFORMATION & STANDARDIZATION ROUTINE

TITLE ***BENEDICT THESIS DATA- TRANS-LOG 10 DATA

NUMBER OF OBSERVATIONS = 266

NUMBER OF VARIABLES = 8

STANDARDIZATION CODE = 0

OUTPUT CODE = 0

TRANSFORMATION CODE = 2

ALPHA = 0.0000000

DATA FILE USED = 1

VARIABLE	NUMBER	MEAN	STANDARD DEVIATION
AG	1	-1.3930985	0.8452252
AS	2	-0.3497241	0.9803129
AU	3	-2.3275427	0.6646484
BI	4	-1.8026105	0.6961547
SB	5	-0.5650136	0.9089375
SE	6	-1.5573078	0.9117588
TE	7	-2.0580026	0.8182847
TL	8	-1.9409646	0.6412031

```
DISTRIBUTION STATISTICS ROUTINE
TITLE  *** BENEDICT THESIS DATA- DSTATS-LOG 10 DATA

STATISTICS FOR VARIABLE (  1)  AG
DATA FILE USED = 2
HISTOGRAM CODE =   1
NUMBER OF OBSERVATIONS =                          266

MINIMUM VALUE =                                   -2.698970
FIRST QUARTILE =                                  -1.958607
SECOND QUARTILE (MEDIAN) =                        -1.408935
THIRD QUARTILE =                                  -1.000000
MAXIMUM =                                          1.973128
RANGE =                                            4.672098
MID POINT =                                        2.336049
EMPIRICAL MODE =                                  -1.440609
SUM =                                           -370.564193
MEAN =                                            -1.393098
STANDARD ERROR OF THE MEAN =                       0.051727
FIRST MOMENT ABOUT THE MEAN (SHOULD = 0) =         0.000000
SECOND MOMENT ABOUT THE MEAN (VARIANCE) =          0.711720
THIRD MOMENT ABOUT THE MEAN =                      0.542799
FOURTH MOMENT ABOUT THE MEAN =                     2.538156
STANDARD DEVIATION =                               0.843635
MEAN DEVIATION =                                   0.632321
COEFFICIENT OF VARIATION =                       -60.558173
BETA1 (MEASURE OF SKEWNESS) =                      0.817243
ALPHA3 (MEASURE OF SKEWNESS) =                     0.904015
STANDARD ERROR FOR SKEWNESS =                      0.150188
PEARSONIAN COEFFICIENT FOR SKEWNESS =              0.056317
BETA2 (ALPHA4) (KURTOSIS) =                        5.010718
```

CHI SQUARE TEST FOR NORMALLITY

EXPECTED FREQUENCY = 10.23077

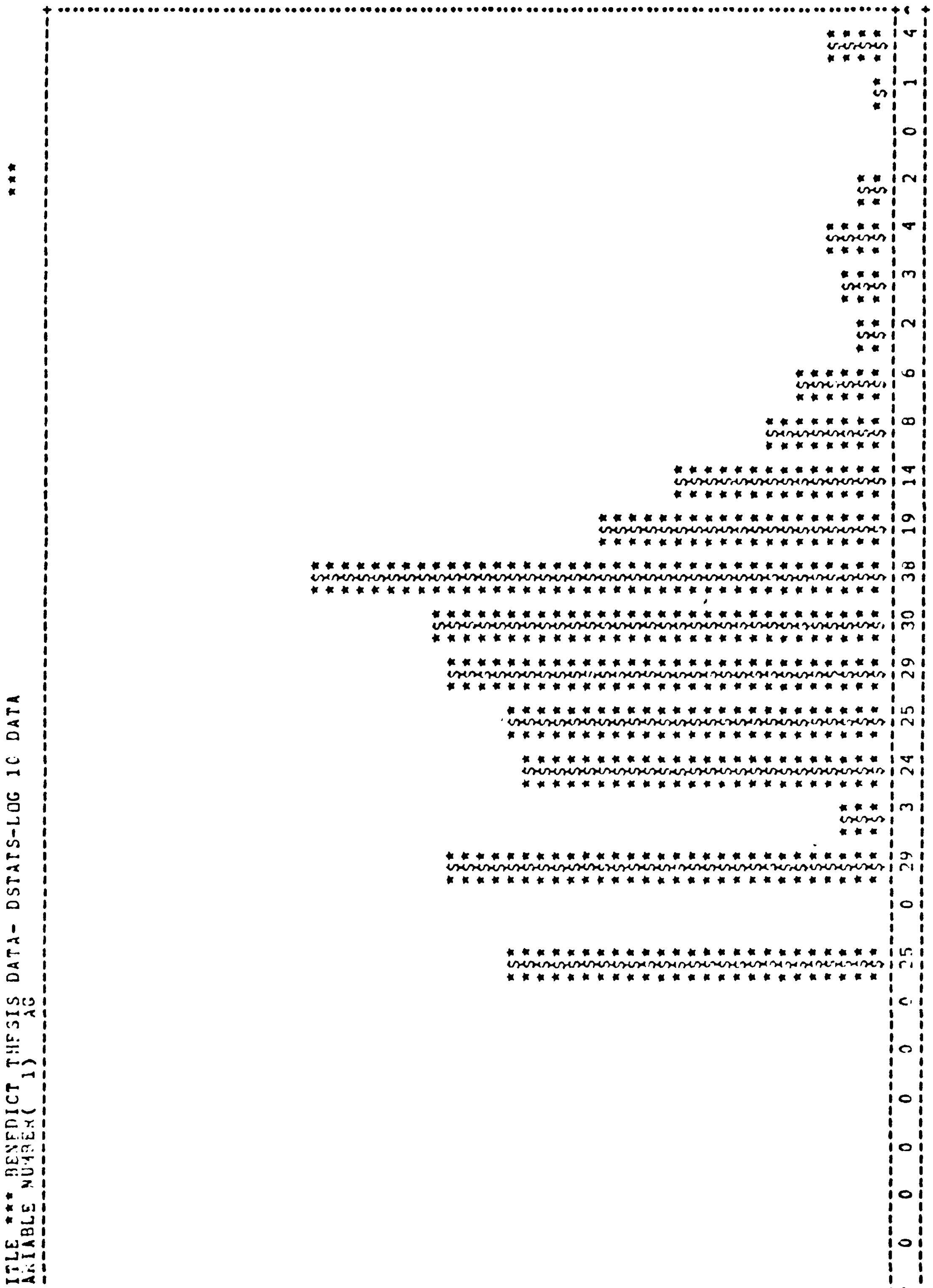
CLASS	UPPER CLASS LIMIT	FREQUENCY
1	-2.88567	0
2	-2.59641	24
3	-2.40420	0
4	-2.25356	27
5	-2.12646	1
6	-2.01407	0
7	-1.91176	10
8	-1.81660	12
9	-1.72657	9
10	-1.64024	10
11	-1.55648	7
12	-1.47436	6
13	-1.39310	17
14	-1.31183	8
15	-1.22972	12
16	-1.14596	12
17	-1.05962	19
18	-0.96960	12
19	-0.87443	11
20	-0.77213	5
21	-0.65974	5
22	-0.53254	8
23	-0.38200	5
24	-0.18979	6
25	0.09948	2
26	************	13

CHI SQUARE = 119.36090 WITH 24 DEGREES OF FREEDOM

IF CHI SQUARE IS LESS THAN 36.41 THEN WE CAN BE 95%CONFIDENT THAT THE DATA IS NORMALLY DISTRIBUTED

FREQUENCY DISTRIBUTION TABLE

CLASS	UPPER CLASS LIMIT	FREQUENCY	PERCENT OF TOTAL	CUMLATIVE PERCENT
1	-3.92400	0	0.00	0.00
2	-3.71309	0	0.00	0.00
3	-3.50219	0	0.00	0.00
4	-3.29128	0	0.00	0.00
5	-3.08037	0	0.00	0.00
6	-2.86946	0	0.00	0.00
7	-2.65855	25	9.40	9.40
8	-2.44764	0	0.00	9.40
9	-2.23673	29	10.90	20.30
10	-2.02582	3	1.13	21.43
11	-1.81492	24	9.02	30.45
12	-1.60401	25	9.40	39.85
13	-1.39310	29	10.90	50.75
14	-1.18219	30	11.28	62.03
15	-0.97128	38	14.29	76.32
16	-0.76037	19	7.14	83.46
17	-0.54946	14	5.26	88.72
18	-0.33855	8	3.01	91.73
19	-0.12765	6	2.26	93.98
20	0.08326	2	0.75	94.74
21	0.29417	3	1.13	95.86
22	0.50508	4	1.50	97.37
23	0.71599	2	0.75	98.12
24	0.92690	0	0.00	98.12
25	1.13781	1	0.38	98.50
26	************	4	1.50	100.00


TITLE *** BENEDICT THESIS DATA- DSTATS-LOG 10 DATA
VARIABLE NUMBER(1) AG
***
0 0 0 0 0 0 0 25 0 29 3 24 25 29 30 38 19 14 8 6 2 3 4 2 0 1 4

```
DISTRIBUTION STATISTICS ROUTINE
TITLE  *** BENEDICT THESIS DATA- DSTATS-LOG 10 DATA

STATISTICS FOR VARIABLE (   2)  AS
DATA FILE USED = 2
HISTOGRAM CODE =    1
NUMBER OF OBSERVATIONS =                           266

MINIMUM VALUE =                                       -1.698970
FIRST QUARTILE =                                      -1.045757
SECOND QUARTILE (MEDIAN) =                            -0.657577
THIRD QUARTILE =                                       0.041393
MAXIMUM =                                              3.919078
RANGE =                                                5.618048
MID POINT =                                            2.809024
EMPIRICAL MODE =                                      -1.273284
SUM =                                                -93.026619
MEAN =                                                -0.349724
STANDARD ERROR OF THE MEAN =                           0.059994
FIRST MOMENT ABOUT THE MEAN (SHOULD = 0) =            -0.000000
SECOND MOMENT ABOUT THE MEAN (VARIANCE) =              0.957401
THIRD MOMENT ABOUT THE MEAN =                          1.571645
FOURTH MOMENT ABOUT THE MEAN =                         5.445311
STANDARD DEVIATION =                                   0.978468
MEAN DEVIATION =                                       0.724722
COEFFICIENT OF VARIATION =                          -279.782949
BETA1 (MEASURE OF SKEWNESS) =                          2.814674
ALPHA3 (MEASURE OF SKEWNESS) =                         1.677699
STANDARD ERROR FOR SKEWNESS =                          0.150188
PEARSONIAN COEFFICIENT FOR SKEWNESS =                  0.943883
BETA2 (ALPHA4) (KURTOSIS) =                            5.940669
```

CHI SQUARE TEST FOR NORMALLITY

EXPECTED FREQUENCY = 10.23077

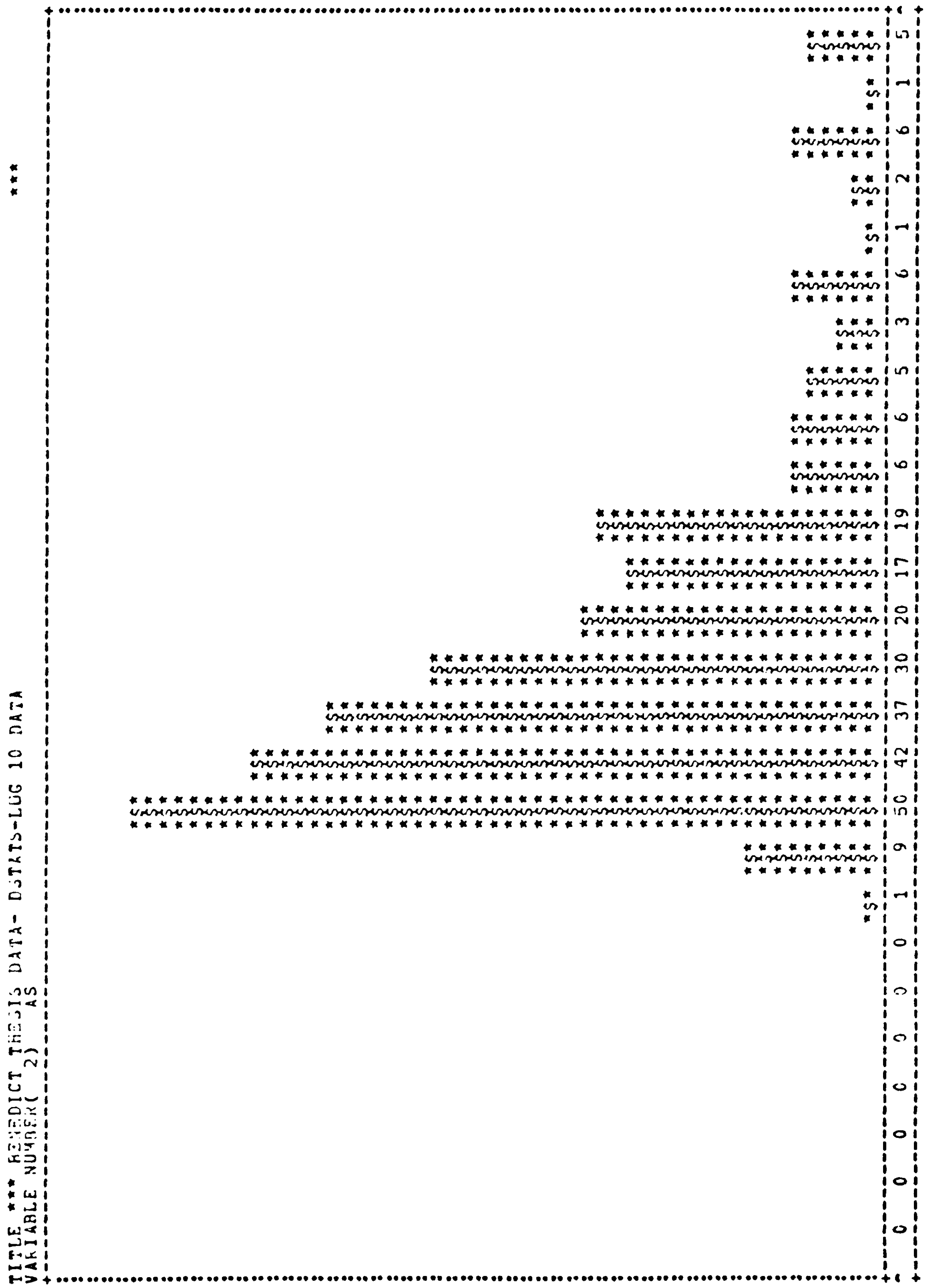
CLASS	UPPER CLASS LIMIT	FREQUENCY
1	-2.08085	0
2	-1.74535	0
3	-1.52242	0
4	-1.34782	7
5	-1.20029	23
6	-1.06994	25
7	-0.95128	24
8	-0.84091	16
9	-0.73650	16
10	-0.63637	15
11	-0.53922	13
12	-0.44398	9
13	-0.34972	9
14	-0.25547	12
15	-0.16023	3
16	-0.06308	5
17	0.03705	5
18	0.14146	7
19	0.25184	6
20	0.37049	10
21	0.50084	3
22	0.64837	2
23	0.82297	4
24	1.04590	4
25	1.38140	4
26	************	19

CHI SQUARE = 141.45113 WITH 24 DEGREES OF FREEDOM

IF CHI SQUARE IS LESS THAN 36.41 THEN WE CAN BE 95%CONFIDENT THAT THE DATA IS NORMALLY DISTRIBUTED

FREQUENCY DISTRIBUTION TABLE

CLASS	UPPER CLASS LIMIT	FREQUENCY	PERCENT OF TOTAL	CUMLATIVE PERCENT
1	-3.28513	0	0.00	0.00
2	-3.04051	0	0.00	0.00
3	-2.79590	0	0.00	0.00
4	-2.55128	0	0.00	0.00
5	-2.30666	0	0.00	0.00
6	-2.06204	0	0.00	0.00
7	-1.81743	0	0.00	0.00
8	-1.57281	1	0.38	0.38
9	-1.32819	9	3.38	3.76
10	-1.08358	50	18.80	22.56
11	-0.83896	42	15.79	38.35
12	-0.59434	37	13.91	52.26
13	-0.34972	30	11.28	63.53
14	-0.10511	20	7.52	71.05
15	0.13951	17	6.39	77.44
16	0.38413	19	7.14	84.59
17	0.62874	6	2.26	86.84
18	0.87336	6	2.26	89.10
19	1.11798	5	1.88	90.98
20	1.36260	3	1.13	92.11
21	1.60721	6	2.26	94.36
22	1.85183	1	0.38	94.74
23	2.09645	2	0.75	95.49
24	2.34106	6	2.26	97.74
25	2.58568	1	0.38	96.12
26	************	5	1.88	100.00


TITLE *** BENEDICT THESIS DATA- DSTATS-LOG 10 DATA ***
VARIABLE NUMBER(2) AS
0 0 0 0 0 0 0 1 9 50 42 37 30 20 17 19 6 6 5 3 6 1 2 6 1 5

```
DISTRIBUTION STATISTICS ROUTINE
TITLE  *** BENEDICT THESIS DATA- DSTATS-LOG 10 DATA

STATISTICS FOR VARIABLE (   3)  AU
DATA FILE USED = 2
HISTOGRAM CODE =    1
NUMBER OF OBSERVATIONS =                          266
MINIMUM VALUE =                                       -2.698970
FIRST QUARTILE =                                      -2.698970
SECOND QUARTILE (MEDIAN) =                            -2.698970
THIRD QUARTILE =                                      -2.154902
MAXIMUM =                                              0.845098
RANGE =                                                3.544068
MID POINT =                                            1.772034
EMPIRICAL MODE =                                      -3.441825
SUM =                                               -619.126371
MEAN =                                                -2.327543
STANDARD ERROR OF THE MEAN =                           0.040676
FIRST MOMENT ABOUT THE MEAN (SHOULD = 0) =            -0.000000
SECOND MOMENT ABOUT THE MEAN (VARIANCE) =              0.440097
THIRD MOMENT ABOUT THE MEAN =                          0.571384
FOURTH MOMENT ABOUT THE MEAN =                         1.320715
STANDARD DEVIATION =                                   0.663398
MEAN DEVIATION =                                       0.511062
COEFFICIENT OF VARIATION =                           -28.502070
BETA1 (MEASURE OF SKEWNESS) =                          3.830112
ALPHA3 (MEASURE OF SKEWNESS) =                         1.957067
STANDARD ERROR FOR SKEWNESS =                          0.150188
PEARSONIAN COEFFICIENT FOR SKEWNESS =                  1.679658
BETA2 (ALPHA4) (KURTOSIS) =                            6.818875
```

CHI SQUARE TEST FOR NORMALLITY

EXPECTED FREQUENCY = 10.23077

CLASS	UPPER CLASS LIMIT	FREQUENCY
1	-3.50124	0
2	-3.27377	0
3	-3.12263	0
4	-3.00425	0
5	-2.90422	0
6	-2.81585	0
7	-2.73540	0
8	-2.66056	176
9	-2.58977	0
10	-2.52188	0
11	-2.45602	0
12	-2.39145	0
13	-2.32754	0
14	-2.26364	4
15	-2.19907	1
16	-2.13320	8
17	-2.06531	0
18	-1.99452	4
19	-1.91969	0
20	-1.83924	1
21	-1.75066	3
22	-1.65084	2
23	-1.53246	1
24	-1.38131	10
25	-1.15385	9
26	************	22

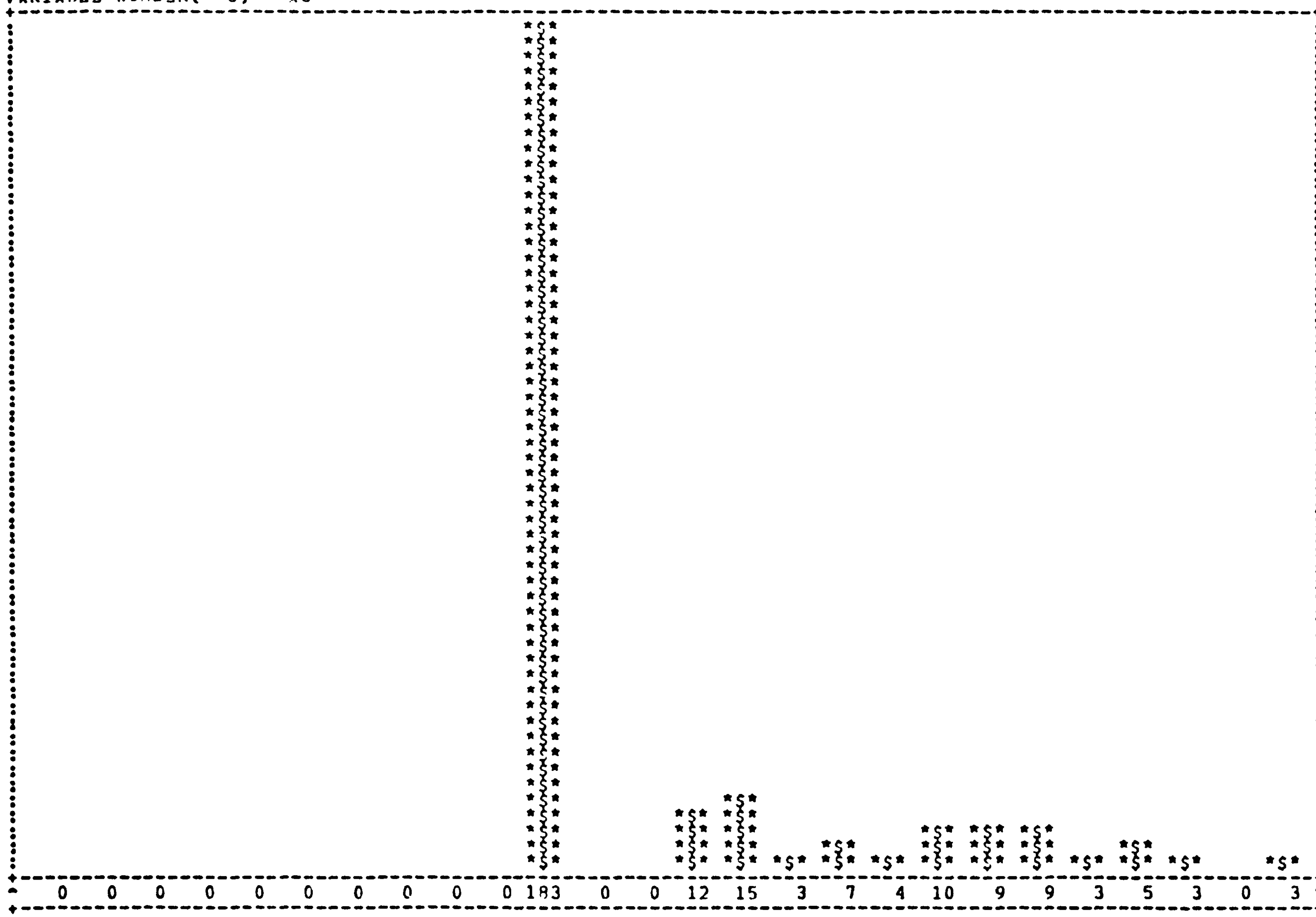
CHI SQUARE = 2887.67668 WITH 24 DEGREES OF FREEDOM

IF CHI SQUARE IS LESS THAN 36.41 THEN WE CAN BE 95%CONFIDENT THAT THE DATA IS NORMALLY DISTRIBUTED

FREQUENCY DISTRIBUTION TABLE

CLASS	UPPER CLASS LIMIT	FREQUENCY	PERCENT OF TOTAL	CUMLATIVE PERCENT
1	-4.31774	0	0.00	0.00
2	-4.15189	0	0.00	0.00
3	-3.98604	0	0.00	0.00
4	-3.82019	0	0.00	0.00
5	-3.65434	0	0.00	0.00
6	-3.48849	0	0.00	0.00
7	-3.32264	0	0.00	0.00
8	-3.15679	0	0.00	0.00
9	-2.99094	0	0.00	0.00
10	-2.82509	0	0.00	0.00
11	-2.65924	183	68.80	68.80
12	-2.49339	0	0.00	68.80
13	-2.32754	0	0.00	68.80
14	-2.16169	12	4.51	73.31
15	-1.99584	15	5.64	78.95
16	-1.82999	3	1.13	80.08
17	-1.66414	7	2.63	82.71
18	-1.49830	4	1.50	84.21
19	-1.33245	10	3.76	87.97
20	-1.16660	9	3.38	91.35
21	-1.00075	9	3.38	94.74
22	-0.83490	3	1.13	95.86
23	-0.66905	5	1.88	97.74
24	-0.50320	3	1.13	98.87
25	-0.33735	0	0.00	98.87
26	************	3	1.13	100.00

TITLE *** BENEDICT THESIS DATA- DSTATS-LOG 10 DATA ***
VARIABLE NUMBER(3) AU



```
DISTRIBUTION STATISTICS ROUTINE
TITLE  *** BENEDICT THESIS DATA- DSTATS-LOG 10 DATA                    ***

STATISTICS FOR VARIABLE (  4)  BI
DATA FILE USED = 2
HISTOGRAM CODE =    1
NUMBER OF OBSERVATIONS =                          266

MINIMUM VALUE =                                     -2.301030
FIRST QUARTILE =                                    -2.301030
SECOND QUARTILE (MEDIAN).=                          -2.000000
THIRD QUARTILE =                                    -1.698970
MAXIMUM =                                            1.361728
RANGE =                                              3.662758
MID POINT =                                          1.831379
EMPIRICAL MODE =                                    -2.394379
SUM =                                             -479.547600
MEAN =                                              -1.802811
STANDARD ERROR OF THE MEAN =                         0.042604
FIRST MOMENT ABOUT THE MEAN (SHOULD = 0) =           0.000000
SECOND MOMENT ABOUT THE MEAN (VARIANCE) =            0.482809
THIRD MOMENT ABOUT THE MEAN =                        0.728266
FOURTH MOMENT ABOUT THE MEAN =                       1.891445
STANDARD DEVIATION =                                 0.694845
MEAN DEVIATION =                                     0.481539
COEFFICIENT OF VARIATION =                         -38.542316
BETA1 (MEASURE OF SKEWNESS) =                        4.712516
ALPHA3 (MEASURE OF SKEWNESS) =                       2.170833
STANDARD ERROR FOR SKEWNESS =                        0.150188
PEARSONIAN COEFFICIENT FOR SKEWNESS =                0.851368
BETA2 (ALPHA4) (KURTOSIS) =                          8.114136
```

CHI SQUARE TEST FOR NORMALLITY

EXPECTED FREQUENCY = 10.23077

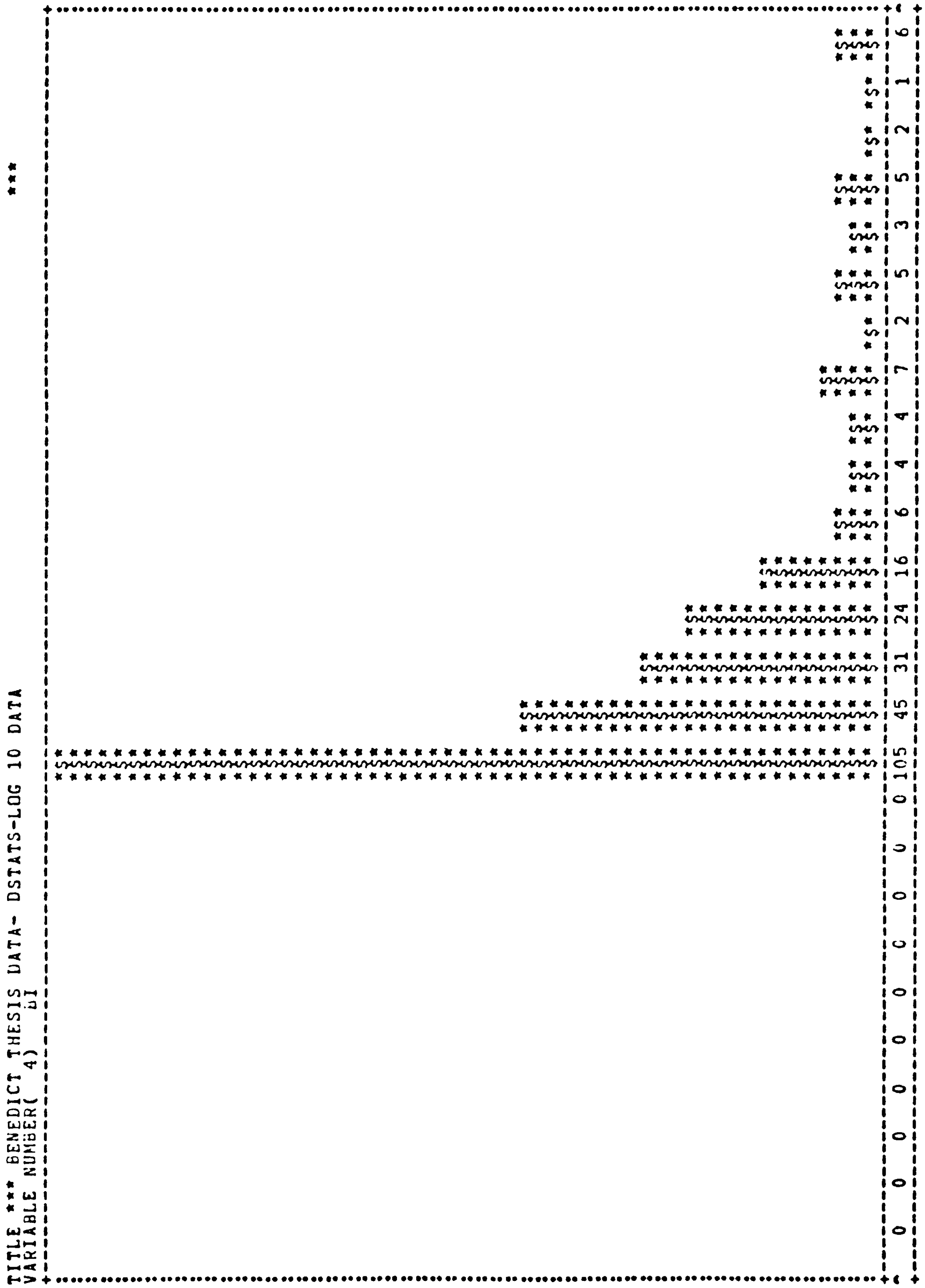
CLASS	UPPER CLASS LIMIT	FREQUENCY
1	-3.03214	0
2	-2.79339	0
3	-2.63558	0
4	-2.51159	0
5	-2.40683	0
6	-2.31426	0
7	-2.23000	99
8	-2.15162	0
9	-2.07747	0
10	-2.00636	0
11	-1.93737	46
12	-1.86974	14
13	-1.80281	10
14	-1.73588	10
15	-1.66825	9
16	-1.59926	7
17	-1.52815	3
18	-1.45400	6
19	-1.37562	1
20	-1.29136	3
21	-1.19879	0
22	-1.09403	4
23	-0.97004	0
24	-0.81173	6
25	-0.57348	3
26	************	20

CHI SQUARE = 1050.66917 WITH 24 DEGREES OF FREEDOM

IF CHI SQUARE IS LESS THAN 36.41 THEN WE CAN BE 95%CONFIDENT THAT THE DATA IS NORMALLY DISTRIBUTED

FREQUENCY DISTRIBUTION TABLE

CLASS	UPPER CLASS LIMIT	FREQUENCY	PERCENT OF TOTAL	CUMLATIVE PERCENT
1	-3.88735	0	0.00	0.00
2	-3.71363	0	0.00	0.00
3	-3.53992	0	0.00	0.00
4	-3.36621	0	0.00	0.00
5	-3.19250	0	0.00	0.00
6	-3.01879	0	0.00	0.00
7	-2.84508	0	0.00	0.00
8	-2.67137	0	0.00	0.00
9	-2.49766	0	0.00	0.00
10	-2.32394	0	0.00	0.00
11	-2.15023	105	39.47	39.47
12	-1.97652	45	16.92	56.39
13	-1.80281	31	11.65	68.05
14	-1.62910	24	9.02	77.07
15	-1.45539	16	6.02	83.08
16	-1.28168	6	2.26	85.34
17	-1.10797	4	1.50	86.84
18	-0.93425	4	1.50	88.35
19	-0.76054	7	2.63	90.98
20	-0.58683	2	0.75	91.73
21	-0.41312	5	1.88	93.61
22	-0.23941	3	1.13	94.74
23	-0.06570	5	1.88	96.62
24	0.10801	2	0.75	97.37
25	0.28172	1	0.38	97.74
26	************	6	2.26	100.00


TITLE *** BENEDICT THESIS DATA- DSTATS-LOG 10 DATA ***
VARIABLE NUMBER(4) BI
0 0 0 0 0 0 0 0 0 0 105 45 31 24 16 6 4 4 7 2 5 3 5 2 1 6

```
DISTRIBUTION STATISTICS ROUTINE
TITLE  *** BENEDICT THESIS DATA- DSTATS-LOG 10 DATA                    ***

STATISTICS FOR VARIABLE (  5)  SB
DATA FILE USED = 2
HISTOGRAM CODE =   1
NUMBER OF OBSERVATIONS =                         266

MINIMUM VALUE =                                  -1.387216
FIRST QUARTILE =                                 -1.161151
SECOND QUARTILE (MEDIAN) =                       -1.026872
THIRD QUARTILE =                                 -0.318759
MAXIMUM =                                         2.596597
RANGE =                                           3.983813
MID POINT =                                       1.991907
EMPIRICAL MODE =                                 -1.950589
SUM =                                          -150.293623
MEAN =                                           -0.565014
STANDARD ERROR OF THE MEAN =                      0.055626
FIRST MOMENT ABOUT THE MEAN (SHOULD = 0) =        0.000000
SECOND MOMENT ABOUT THE MEAN (VARIANCE) =         0.823062
THIRD MOMENT ABOUT THE MEAN =                     1.186791
FOURTH MOMENT ABOUT THE MEAN =                    3.112943
STANDARD DEVIATION =                              0.907227
MEAN DEVIATION =                                  0.702041
COEFFICIENT OF VARIATION =                     -160.567348
BETA1 (MEASURE OF SKEWNESS) =                     2.526108
ALPHA3 (MEASURE OF SKEWNESS) =                    1.589373
STANDARD ERROR FOR SKEWNESS =                     0.150188
PEARSONIAN COEFFICIENT FOR SKEWNESS =             1.527264
BETA2 (ALPHA4) (KURTOSIS) =                       4.595223
```

CHI SQUARE TEST FOR NORMALLITY

EXPECTED FREQUENCY = 10.23077

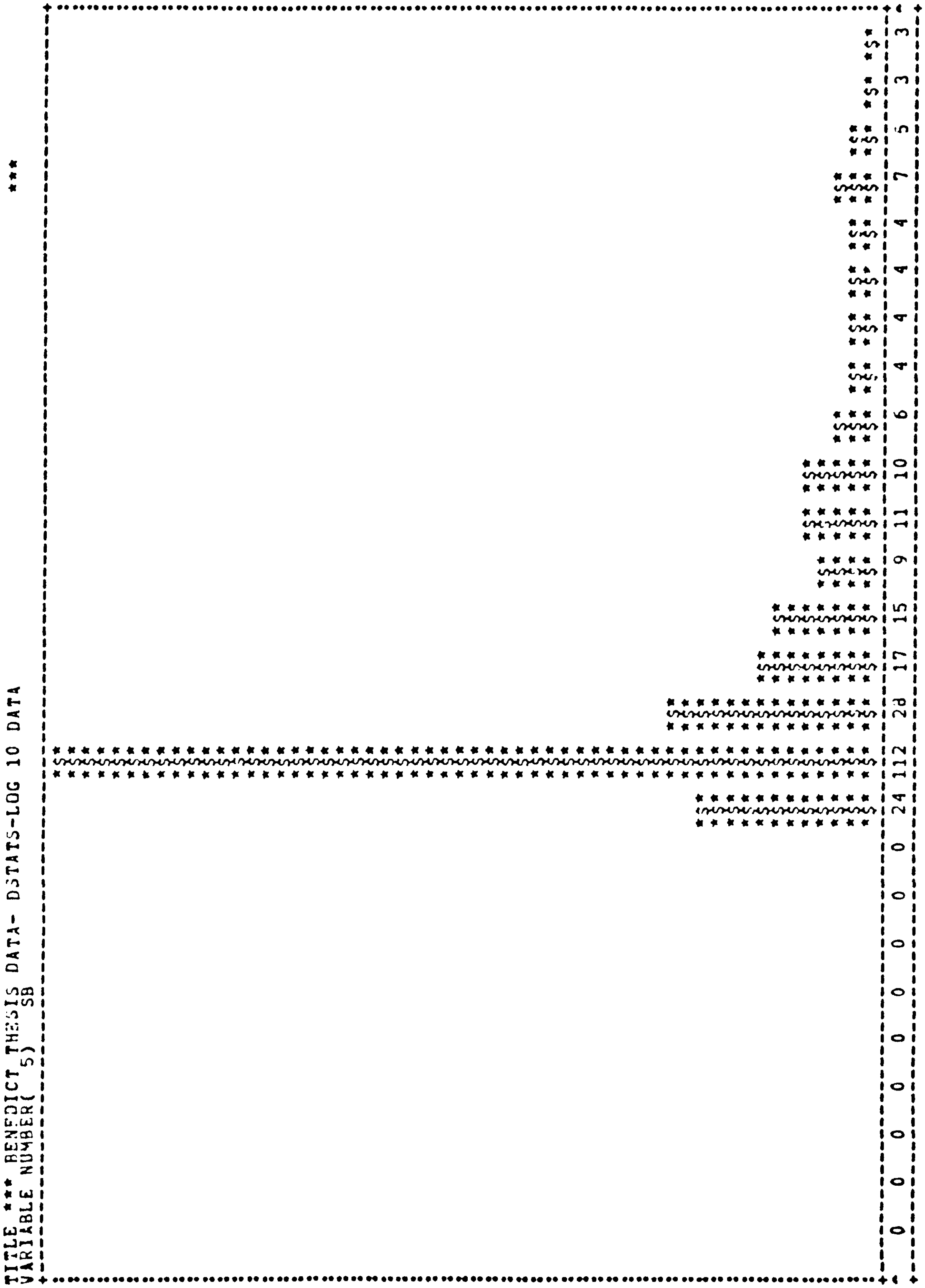
CLASS	UPPER CLASS LIMIT	FREQUENCY
1	-2.17010	0
2	-1.85903	0
3	-1.65233	0
4	-1.49044	0
5	-1.35365	0
6	-1.23279	21
7	-1.12277	68
8	-1.02044	40
9	-0.92363	13
10	-0.83078	7
11	-0.74071	8
12	-0.65241	7
13	-0.56501	5
14	-0.47762	9
15	-0.38932	2
16	-0.29924	5
17	-0.20640	0
18	-0.10959	3
19	-0.00725	3
20	0.10276	6
21	0.22362	0
22	0.36041	8
23	0.52230	2
24	0.72900	5
25	1.04007	4
26	************	25

CHI SQUARE = 558.03759 WITH 24 DEGREES OF FREEDOM

IF CHI SQUARE IS LESS THAN 36.41 THEN WE CAN BE 95%CONFIDENT THAT THE DATA IS NORMALLY DISTRIBUTED

FREQUENCY DISTRIBUTION TABLE

CLASS	UPPER CLASS LIMIT	FREQUENCY	PERCENT OF TOTAL	CUMLATIVE PERCENT
1	-3.28670	0	0.00	0.00
2	-3.05989	0	0.00	0.00
3	-2.83308	0	0.00	0.00
4	-2.60628	0	0.00	0.00
5	-2.37947	0	0.00	0.00
6	-2.15266	0	0.00	0.00
7	-1.92585	0	0.00	0.00
8	-1.69905	0	0.00	0.00
9	-1.47224	0	0.00	0.00
10	-1.24543	24	9.02	9.02
11	-1.01863	112	42.11	51.13
12	-0.79182	28	10.53	61.65
13	-0.56501	17	6.39	68.05
14	-0.33821	15	5.64	73.68
15	-0.11140	9	3.38	77.07
16	0.11541	11	4.14	81.20
17	0.34221	10	3.76	84.96
18	0.56902	6	2.26	87.22
19	0.79583	4	1.50	88.72
20	1.02263	4	1.50	90.23
21	1.24944	4	1.50	91.73
22	1.47625	4	1.50	93.23
23	1.70305	7	2.63	95.86
24	1.92986	5	1.88	97.74
25	2.15667	3	1.13	98.87
26	************	3	1.13	100.00


TITLE *** BENEDICT THESIS DATA- DSTATS-LOG 10 DATA ***
VARIABLE NUMBER(5) SB
0 0 0 0 0 0 0 0 0 24 112 28 17 15 9 11 10 6 4 4 4 4 7 5 3 3

```
DISTRIBUTION STATISTICS ROUTINE
TITLE  *** BENEDICT THESIS DATA- DSTATS-LOG 10 DATA                 ***

STATISTICS FOR VARIABLE (  6)  SE
DATA FILE USED = 2
HISTOGRAM CODE =  1
NUMBER OF OBSERVATIONS =                      266

MINIMUM VALUE =                                -2.698970
FIRST QUARTILE =                               -2.154902
SECOND QUARTILE (MEDIAN) =                     -1.958607
THIRD QUARTILE =                               -1.036212
MAXIMUM =                                       1.462398
RANGE =                                         4.161368
MID POINT =                                     2.080684
EMPIRICAL MODE =                               -2.761206
SUM =                                        -414.243875
MEAN =                                         -1.557308
STANDARD ERROR OF THE MEAN =                    0.055798
FIRST MOMENT ABOUT THE MEAN (SHOULD = 0) =      0.000000
SECOND MOMENT ABOUT THE MEAN (VARIANCE) =       0.828179
THIRD MOMENT ABOUT THE MEAN =                   0.829638
FOURTH MOMENT ABOUT THE MEAN =                  2.220147
STANDARD DEVIATION =                            0.910043
MEAN DEVIATION =                                0.744336
COEFFICIENT OF VARIATION =                    -58.436958
BETA1 (MEASURE OF SKEWNESS) =                   1.211727
ALPHA3 (MEASURE OF SKEWNESS) =                  1.100785
STANDARD ERROR FOR SKEWNESS =                   0.150188
PEARSONIAN COEFFICIENT FOR SKEWNESS =           1.322902
BETA2 (ALPHA4) (KURTOSIS) =                     3.236931
```

CHI SQUARE TEST FOR NORMALLITY

EXPECTED FREQUENCY = 10.23077

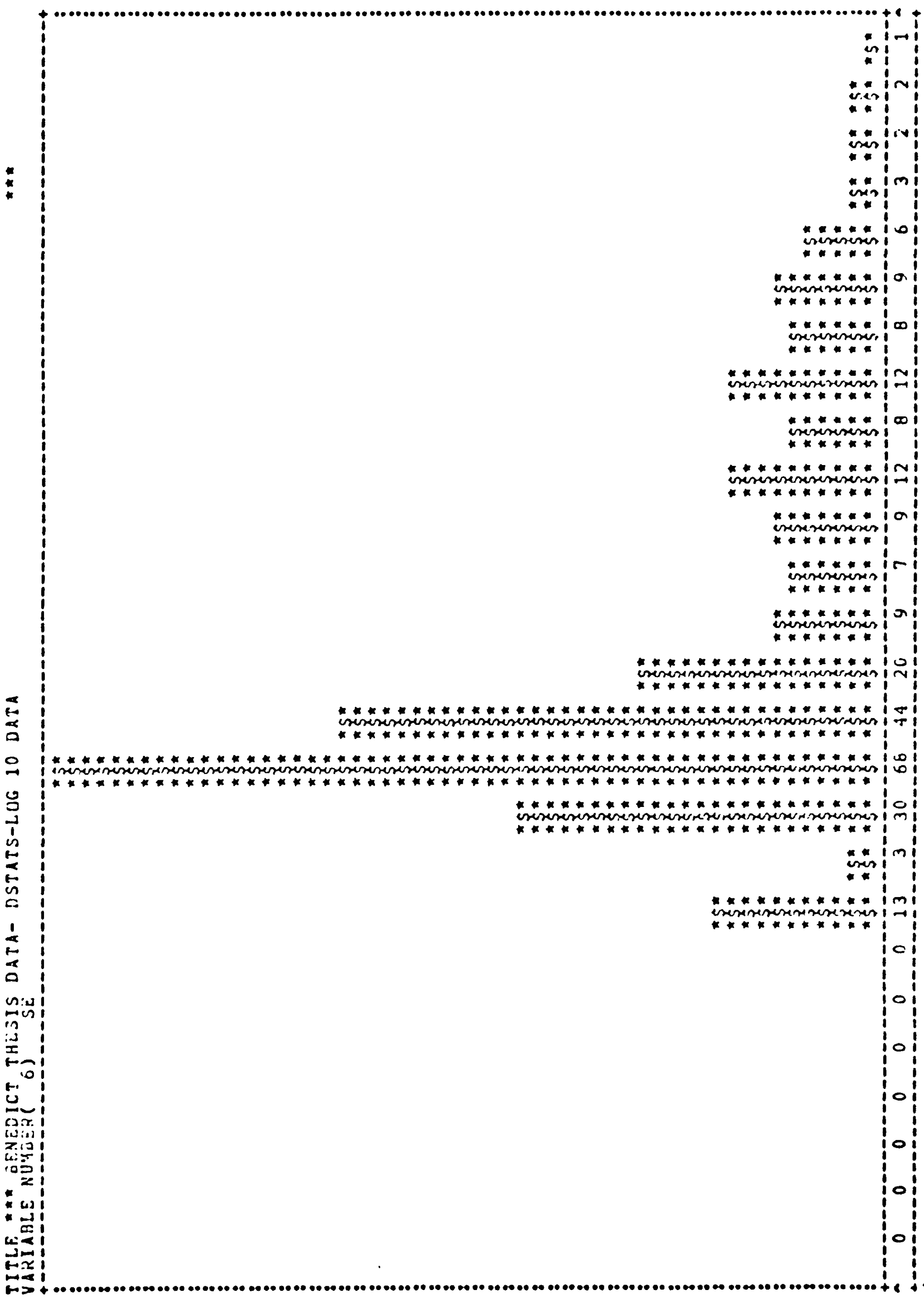
CLASS	UPPER CLASS LIMIT	FREQUENCY
1	-3.16737	0
2	-2.85534	0
3	-2.64800	11
4	-2.48561	2
5	-2.34839	16
6	-2.22716	12
7	-2.11680	30
8	-2.01414	36
9	-1.91703	24
10	-1.82390	15
11	-1.73355	6
12	-1.64497	9
13	-1.55731	5
14	-1.46965	3
15	-1.38107	3
16	-1.29071	1
17	-1.19758	3
18	-1.10047	1
19	-0.99782	6
20	-0.88746	0
21	-0.76622	7
22	-0.62901	7
23	-0.46662	2
24	-0.25928	7
25	0.05276	13
26	************	22

CHI SQUARE = 227.07519 WITH 24 DEGREES OF FREEDOM

IF CHI SQUARE IS LESS THAN 36.41 THEN WE CAN BE 95%CONFIDENT THAT THE DATA IS NORMALLY DISTRIBUTED

FREQUENCY DISTRIBUTION TABLE

CLASS	UPPER CLASS LIMIT	FREQUENCY	PERCENT OF TOTAL	CUMLATIVE PERCENT
1	-4.26744	0	0.00	0.00
2	-4.05993	0	0.00	0.00
3	-3.83242	0	0.00	0.00
4	-3.60491	0	0.00	0.00
5	-3.37739	0	0.00	0.00
6	-3.14988	0	0.00	0.00
7	-2.92237	0	0.00	0.00
8	-2.69486	13	4.89	4.89
9	-2.46735	3	1.13	6.02
10	-2.23984	30	11.28	17.29
11	-2.01233	68	25.56	42.86
12	-1.78482	44	16.54	59.40
13	-1.55731	20	7.52	66.92
14	-1.32980	9	3.38	70.30
15	-1.10229	7	2.63	72.93
16	-0.87478	9	3.38	76.32
17	-0.64726	12	4.51	80.83
18	-0.41975	8	3.01	83.83
19	-0.19224	12	4.51	88.35
20	0.03527	8	3.01	91.35
21	0.26278	9	3.38	94.74
22	0.49029	6	2.26	96.99
23	0.71780	3	1.13	98.12
24	0.94531	2	0.75	98.87
25	1.17282	2	0.75	99.62
26	************	1	0.38	100.00


TITLE *** BENEDICT THESIS DATA- DSTATS-LOG 10 DATA ***
VARIABLE NUMBER(6) SE
0 0 0 0 0 0 0 13 3 30 66 44 20 9 7 9 12 8 12 8 9 6 3 2 2 1

```
DISTRIBUTION STATISTICS ROUTINE
TITLE  *** BENEDICT THESIS DATA- DSTATS-LOG 10 DATA                                   ***

STATISTICS FOR VARIABLE (   7)  TE
DATA FILE USED = 2
HISTOGRAM CODE =    1
NUMBER OF OBSERVATIONS =                          266
MINIMUM VALUE =                                        -3.000000
FIRST QUARTILE =                                       -2.698970
SECOND QUARTILE (MEDIAN) =                             -2.154902
THIRD QUARTILE =                                       -1.744727
MAXIMUM =                                               1.146128
RANGE =                                                 4.146128
MID POINT =                                             2.073064
EMPIRICAL MODE =                                       -2.348701
SUM =                                                -547.428698
MEAN =                                                 -2.058003
STANDARD ERROR OF THE MEAN =                            0.050078
FIRST MOMENT ABOUT THE MEAN (SHOULD = 0) =              0.000000
SECOND MOMENT ABOUT THE MEAN (VARIANCE) =               0.667073
THIRD MOMENT ABOUT THE MEAN =                           0.639323
FOURTH MOMENT ABOUT THE MEAN =                          2.030346
STANDARD DEVIATION =                                    0.816745
MEAN DEVIATION =                                        0.612957
COEFFICIENT OF VARIATION =                            -39.686301
BETA1 (MEASURE OF SKEWNESS) =                           1.376958
ALPHA3 (MEASURE OF SKEWNESS) =                          1.173439
STANDARD ERROR FOR SKEWNESS =                           0.150188
PEARSONIAN COEFFICIENT FOR SKEWNESS =                   0.355923
BETA2 (ALPHA4) (KURTOSIS) =                             4.562721
```

CHI SQUARE TEST FOR NORMALLITY

EXPECTED FREQUENCY = 10.23077

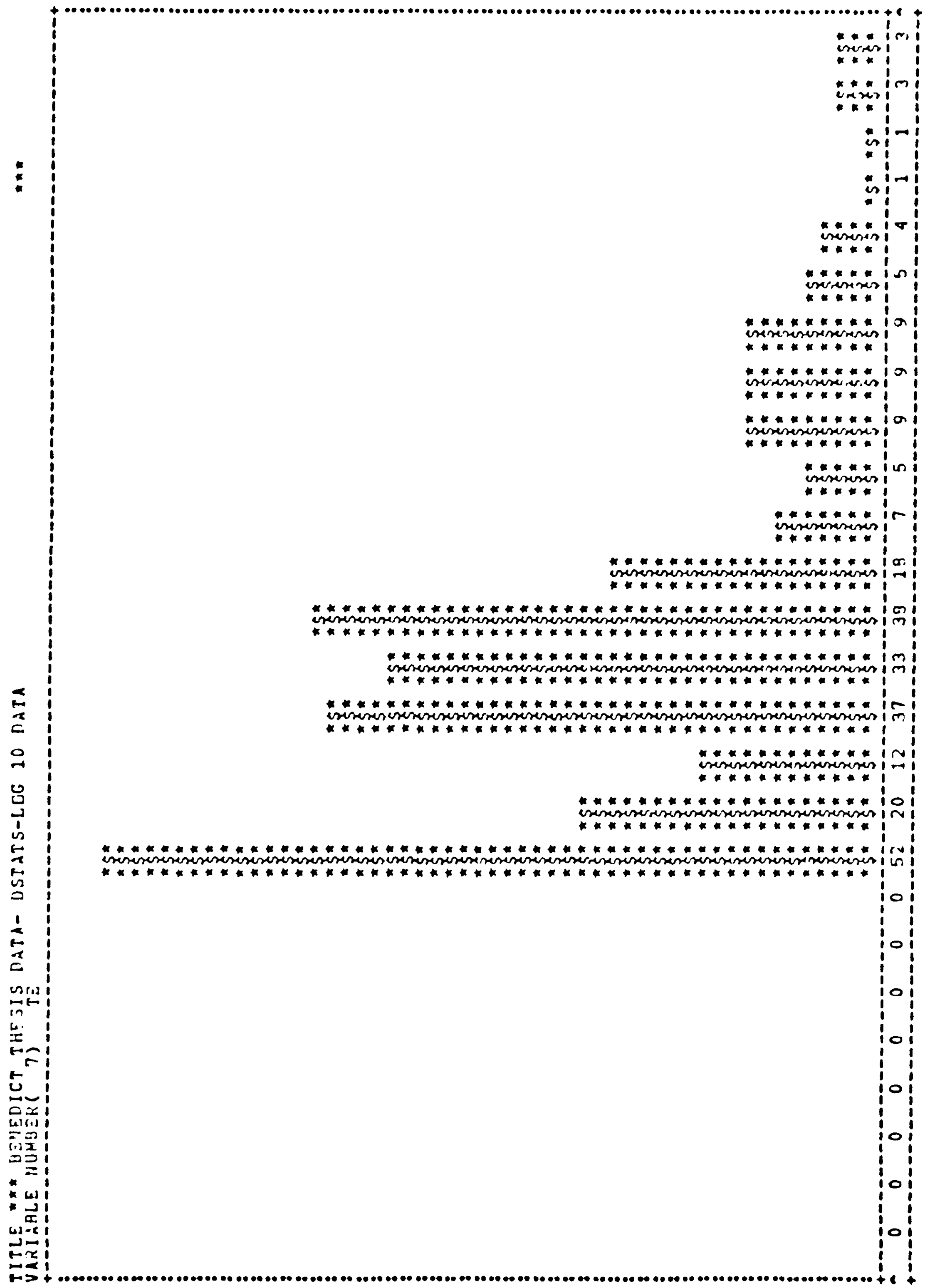
CLASS	UPPER CLASS LIMIT	FREQUENCY
1	-3.50300	0
2	-3.22296	0
3	-3.03687	0
4	-2.89113	49
5	-2.76799	0
6	-2.65918	18
7	-2.56014	0
8	-2.46800	10
9	-2.38035	19
10	-2.29727	16
11	-2.21617	7
12	-2.13658	15
13	-2.05800	8
14	-1.97933	14
15	-1.89983	8
16	-1.81874	15
17	-1.73516	9
18	-1.64800	5
19	-1.55587	5
20	-1.45683	0
21	-1.34802	0
22	-1.22487	3
23	-1.07913	7
24	-0.89305	5
25	-0.61300	14
26	************	14

CHI SQUARE = 260.11278 WITH 24 DEGREES OF FREEDOM

IF CHI SQUARE IS LESS THAN 36.41 THEN WE CAN BE 95%CONFIDENT THAT THE DATA IS NORMALLY DISTRIBUTED

FREQUENCY DISTRIBUTION TABLE

CLASS	UPPER CLASS LIMIT	FREQUENCY	PERCENT OF TOTAL	CUMLATIVE PERCENT
1	-4.50824	0	0.00	0.00
2	-4.30405	0	0.00	0.00
3	-4.09987	0	0.00	0.00
4	-3.89568	0	0.00	0.00
5	-3.69149	0	0.00	0.00
6	-3.48731	0	0.00	0.00
7	-3.28312	0	0.00	0.00
8	-3.07893	0	0.00	0.00
9	-2.87475	52	19.55	19.55
10	-2.67056	20	7.52	27.07
11	-2.46638	12	4.51	31.58
12	-2.26219	37	13.91	45.49
13	-2.05800	33	12.41	57.89
14	-1.85382	38	14.29	72.18
15	-1.64963	18	6.77	78.95
16	-1.44544	7	2.63	81.58
17	-1.24126	5	1.88	83.46
18	-1.03707	9	3.38	86.84
19	-0.83288	9	3.38	90.23
20	-0.62870	9	3.38	93.61
21	-0.42451	5	1.88	95.49
22	-0.22033	4	1.50	96.99
23	-0.01614	1	0.38	97.37
24	0.18805	1	0.38	97.74
25	0.39223	3	1.13	98.87
26	************	3	1.13	100.00


TITLE *** BENEDICT THESIS DATA- DSTATS-LOG 10 DATA ***
VARIABLE NUMBER(7) TE

```
DISTRIBUTION STATISTICS ROUTINE
TITLE  *** BENEDICT THESIS DATA- DSTATS-LOG 10 DATA                         ***

STATISTICS FOR VARIABLE (  8)  TL
DATA FILE USED = 2
HISTOGRAM CODE =  1
NUMBER OF OBSERVATIONS =                              266

MINIMUM VALUE =                                         -2.698970
FIRST QUARTILE =                                        -2.698970
SECOND QUARTILE (MEDIAN) =                              -2.045757
THIRD QUARTILE =                                        -1.397940
MAXIMUM =                                               -0.455932
RANGE =                                                  2.243038
MID POINT =                                              1.121519
EMPIRICAL MODE =                                        -2.255343
SUM =                                                 -516.296576
MEAN =                                                  -1.940965
STANDARD ERROR OF THE MEAN =                             0.039241
FIRST MOMENT ABOUT THE MEAN (SHOULD = 0) =               0.000000
SECOND MOMENT ABOUT THE MEAN (VARIANCE) =                0.409596
THIRD MOMENT ABOUT THE MEAN =                            0.080425
FOURTH MOMENT ABOUT THE MEAN =                           0.316098
STANDARD DEVIATION =                                     0.639997
MEAN DEVIATION =                                         0.552548
COEFFICIENT OF VARIATION =                             -32.973126
BETA1 (MEASURE OF SKEWNESS) =                            0.094127
ALPHA3 (MEASURE OF SKEWNESS) =                           0.306802
STANDARD ERROR FOR SKEWNESS =                            0.150188
PEARSONIAN COEFFICIENT FOR SKEWNESS =                    0.491219
BETA2 (ALPHA4) (KURTOSIS) =                              1.884130
```

CHI SQUARE TEST FOR NORMALLITY

EXPECTED FREQUENCY = 10.23077

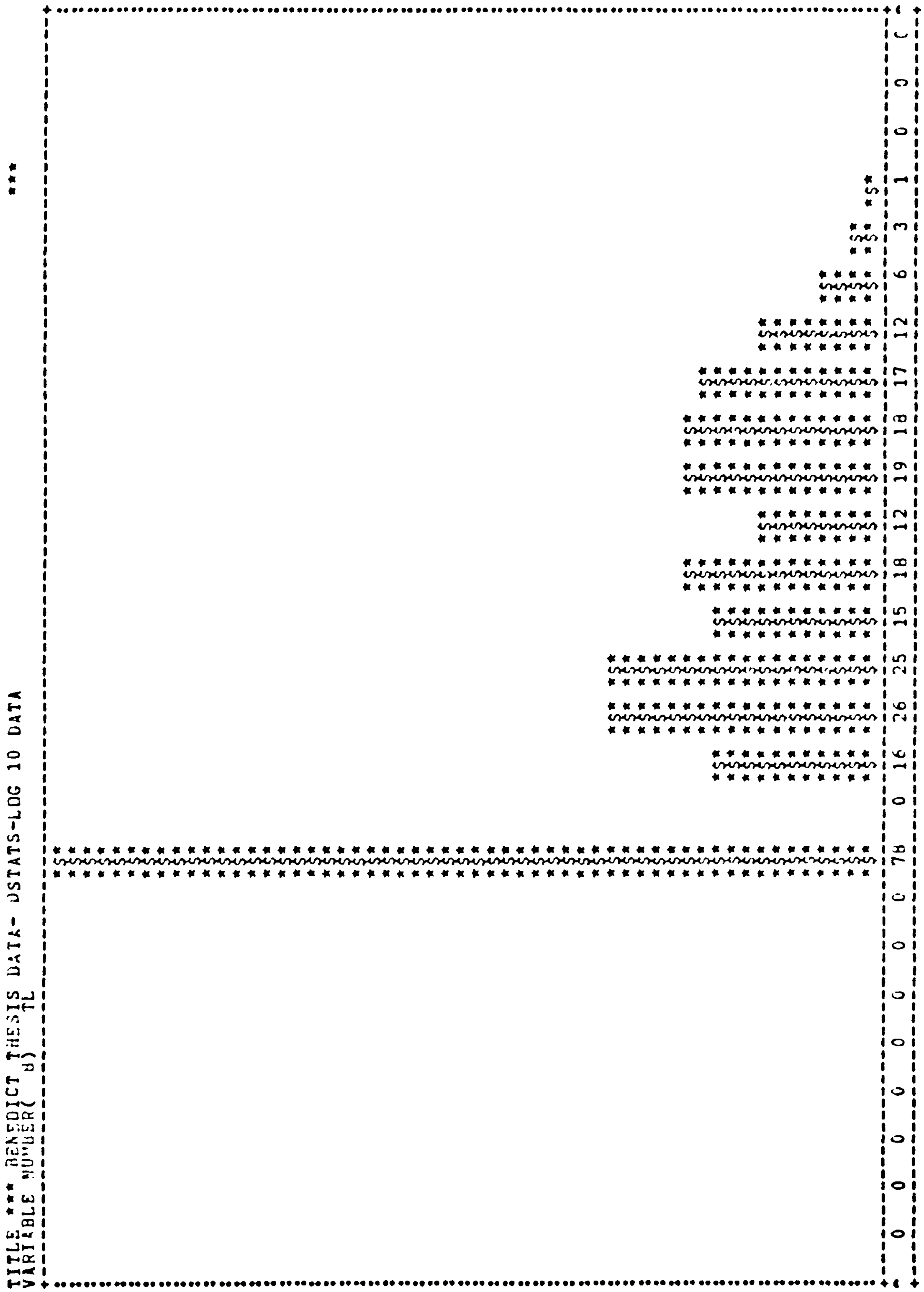
CLASS	UPPER CLASS LIMIT	FREQUENCY
1	-3.07326	0
2	-2.85382	0
3	-2.70800	0
4	-2.59380	75
5	-2.49730	0
6	-2.41204	0
7	-2.33443	0
8	-2.26224	12
9	-2.19394	12
10	-2.12845	12
11	-2.06491	5
12	-2.00261	6
13	-1.94096	11
14	-1.87931	3
15	-1.81702	9
16	-1.75348	6
17	-1.68798	5
18	-1.61969	6
19	-1.54750	4
20	-1.46989	5
21	-1.38463	9
22	-1.28813	9
23	-1.17393	13
24	-1.02811	15
25	-0.80867	15
26	*************	9

CHI SQUARE = 500.36842 WITH 24 DEGREES OF FREEDOM

IF CHI SQUARE IS LESS THAN 36.41 THEN WE CAN BE 95%CONFIDENT THAT THE DATA IS NORMALLY DISTRIBUTED

FREQUENCY DISTRIBUTION TABLE

CLASS	UPPER CLASS LIMIT	FREQUENCY	PERCENT OF TOTAL	CUMLATIVE PERCENT
1	-3.86095	0	0.00	0.00
2	-3.70096	0	0.00	0.00
3	-3.54096	0	0.00	0.00
4	-3.38096	0	0.00	0.00
5	-3.22096	0	0.00	0.00
6	-3.06096	0	0.00	0.00
7	-2.90096	0	0.00	0.00
8	-2.74096	0	0.00	0.00
9	-2.58096	78	29.32	29.32
10	-2.42096	0	0.00	29.32
11	-2.26096	16	6.02	35.34
12	-2.10096	26	9.77	45.11
13	-1.94096	25	9.40	54.51
14	-1.78097	15	5.64	60.15
15	-1.62097	18	6.77	66.92
16	-1.46097	12	4.51	71.43
17	-1.30097	19	7.14	78.57
18	-1.14097	18	6.77	85.34
19	-0.98097	17	6.39	91.73
20	-0.82097	12	4.51	96.24
21	-0.66097	6	2.26	98.50
22	-0.50097	3	1.13	99.62
23	-0.34097	1	0.38	100.00
24	-0.18097	0	0.00	100.00
25	-0.02097	0	0.00	100.00
26	************	0	0.00	100.00


TITLE *** BENEDICT THESIS DATA- DSTATS-LOG 10 DATA ***
VARIABLE NUMBER(8) TL
0 0 0 0 0 0 0 0 0 78 0 16 26 25 15 18 12 19 18 17 12 6 3 1 0 0 0

APPENDIX C: BASIC STATISTICAL PROCESSING RESULTS (raw data)

```
DISTRIBUTION STATISTICS ROUTINE
TITLE  *** BENEDICT THESIS DATA- DSTAT-RAW DATA                                   ***

STATISTICS FOR VARIABLE (  1)  AG
DATA FILE USED = 1
HISTOGRAM CODE =   1
NUMBER OF OBSERVATIONS =                            266

MINIMUM VALUE =                                          0.002000
FIRST QUARTILE =                                         0.011000
SECOND QUARTILE (MEDIAN) =                               0.039000
THIRD QUARTILE =                                         0.100000
MAXIMUM =                                               94.000000
RANGE =                                                 93.998000
MID POINT =                                             46.999000
EMPIRICAL MODE =                                        -2.383617
SUM =                                                  332.582000
MEAN =                                                   1.250308
STANDARD ERROR OF THE MEAN =                             0.563795
FIRST MOMENT ABOUT THE MEAN (SHOULD = 0) =               0.000000
SECOND MOMENT ABOUT THE MEAN (VARIANCE) =               84.552135
THIRD MOMENT ABOUT THE MEAN =                         7113.044184
FOURTH MOMENT ABOUT THE MEAN =                      627703.125630
STANDARD DEVIATION =                                     9.195223
MEAN DEVIATION =                                         2.209742
COEFFICIENT OF VARIATION =                             735.436507
BETA1 (MEASURE OF SKEWNESS) =                           83.702279
ALPHA3 (MEASURE OF SKEWNESS) =                           9.148895
STANDARD ERROR FOR SKEWNESS =                            0.150188
PEARSONIAN COEFFICIENT FOR SKEWNESS =                    0.395197
BETA2 (ALPHA4) (KURTOSIS) =                             97.802147
```

CHI SQUARE TEST FOR NORMALLITY

EXPECTED FREQUENCY = 10.23077

CLASS	UPPER CLASS LIMIT	FREQUENCY
1	-15.01807	0
2	-11.86520	0
3	-9.77017	0
4	-8.12938	0
5	-6.74294	0
6	-5.51796	0
7	-4.40289	0
8	-3.36563	0
9	-2.38441	0
10	-1.44342	0
11	-0.53045	0
12	0.36455	229
13	1.25031	11
14	2.13607	2
15	3.03106	2
16	3.94404	1
17	4.88502	0
18	5.86624	0
19	6.90351	0
20	8.01858	0
21	9.24356	0
22	10.63000	1
23	12.27079	1
24	14.36581	1
25	17.51368	1
26	************	1

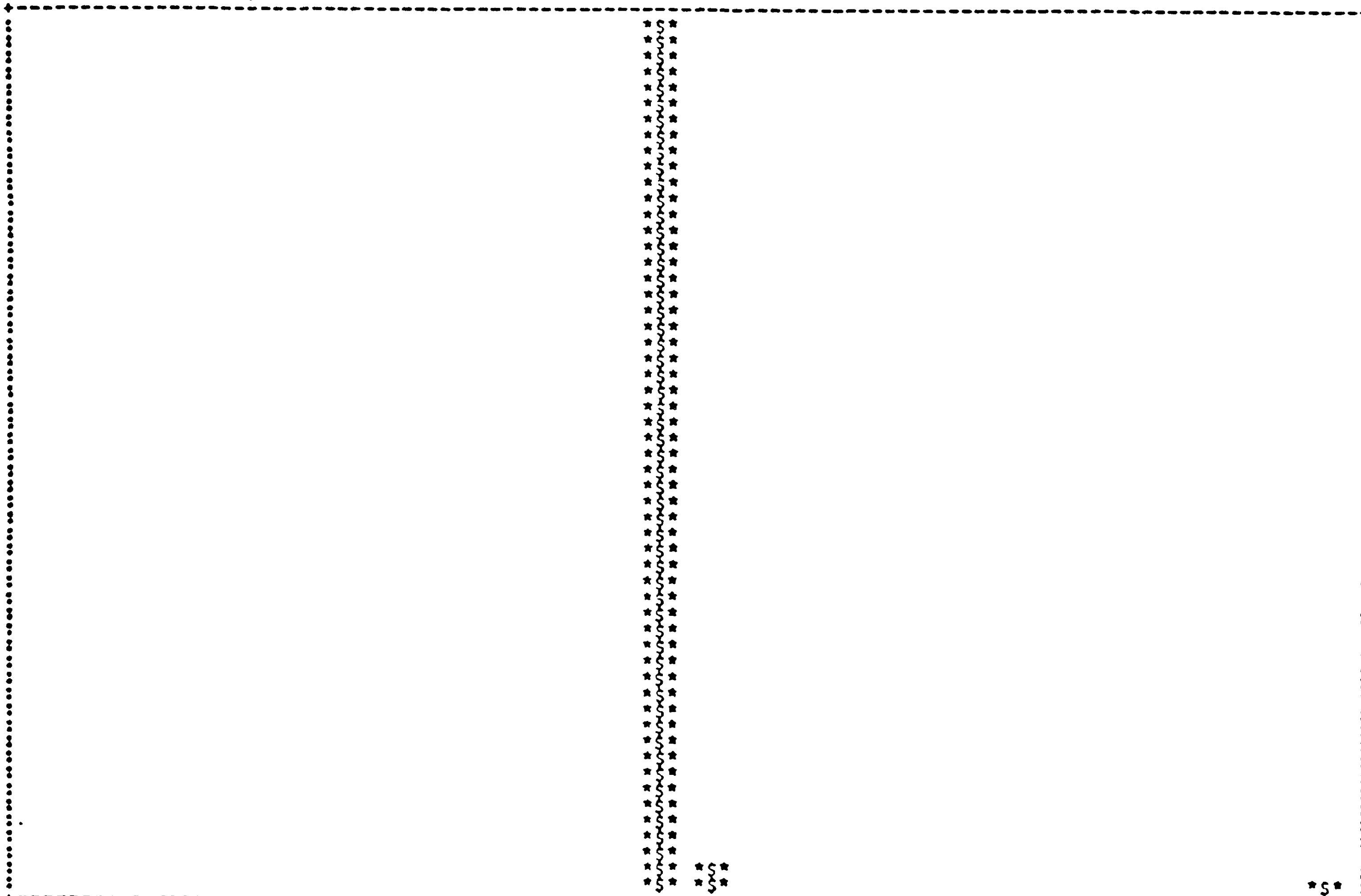
CHI SQUARE = 4905.00750   WITH 24 DEGREES OF FREEDOM

IF CHI SQUARE IS LESS THAN 36.41 THEN WE CAN BE 95%CONFIDENT THAT THE DATA IS NORMALLY DISTRIBUTED

FREQUENCY DISTRIBUTION TABLE

CLASS	UPPER CLASS LIMIT	FREQUENCY	PERCENT OF TOTAL	CUMLATIVE PERCENT
1	-26.33536	0	0.00	0.00
2	-24.03656	0	0.00	0.00
3	-21.73775	0	0.00	0.00
4	-19.43894	0	0.00	0.00
5	-17.14014	0	0.00	0.00
6	-14.84133	0	0.00	0.00
7	-12.54253	0	0.00	0.00
8	-10.24372	0	0.00	0.00
9	-7.94492	0	0.00	0.00
10	-5.64611	0	0.00	0.00
11	-3.34730	0	0.00	0.00
12	-1.04850	0	0.00	0.00
13	1.25031	252	94.74	94.74
14	3.54911	8	3.01	97.74
15	5.84792	1	0.38	98.12
16	8.14673	0	0.00	98.12
17	10.44553	1	0.38	98.50
18	12.74434	0	0.00	98.50
19	15.04314	0	0.00	98.50
20	17.34195	0	0.00	98.50
21	19.64076	0	0.00	98.50
22	21.93956	0	0.00	98.50
23	24.23837	1	0.38	98.87
24	26.53717	0	0.00	98.87
25	28.83598	0	0.00	98.87
26	************	3	1.13	100.00

TITLE *** BENEDICT THESIS DATA- DSTAT-RAW DATA ***
VARIABLE NUMBER(1) AG



0 0 0 0 0 0 0 0 0 0 0 0 252 8 1 0 1 0 0 0 0 0 1 0 0 3

```
DISTRIBUTION STATISTICS ROUTINE
TITLE  *** BENEDICT THESIS DATA- DSTAT-RAW DATA                                    ***

STATISTICS FOR VARIABLE (  2)  AS
DATA FILE USED = 1
HISTOGRAM CODE =   1
NUMBER OF OBSERVATIONS =                              266

MINIMUM VALUE =                                          0.020000
FIRST QUARTILE =                                         0.090000
SECOND QUARTILE (MEDIAN) =                               0.220000
THIRD QUARTILE =                                         1.100000
MAXIMUM =                                             8300.000000
RANGE =                                               8299.980000
MID POINT =                                           4149.990000
EMPIRICAL MODE =                                      -114.309098
SUM =                                                15290.890000
MEAN =                                                  57.484549
STANDARD ERROR OF THE MEAN =                            32.878295
FIRST MOMENT ABOUT THE MEAN (SHOULD = 0) =              -0.000000
SECOND MOMENT ABOUT THE MEAN (VARIANCE) =           287541.282337
THIRD MOMENT ABOUT THE MEAN =                     ***************
FOURTH MOMENT ABOUT THE MEAN =                    ***************
STANDARD DEVIATION =                                   536.228759
MEAN DEVIATION =                                       105.396479
COEFFICIENT OF VARIATION =                             932.822419
BETA1 (MEASURE OF SKEWNESS) =                          196.630911
ALPHA3 (MEASURE OF SKEWNESS) =                          14.022514
STANDARD ERROR FOR SKEWNESS =                            0.150188
PEARSONIAN COEFFICIENT FOR SKEWNESS =                    0.320374
BETA2 (ALPHA4) (KURTOSIS) =                            211.391663
```

CHI SQUARE TEST FOR NORMALLITY

EXPECTED FREQUENCY = 10.23077

CLASS	UPPER CLASS LIMIT	FREQUENCY
1	-891.22222	0
2	-707.35936	0
3	-585.18599	0
4	-489.50155	0
5	-408.64989	0
6	-337.21405	0
7	-272.16758	0
8	-211.69842	0
9	-154.47758	0
10	-99.60303	0
11	-46.36193	0
12	5.83071	222
13	57.46460	17
14	109.13839	2
15	161.33103	0
16	214.57213	4
17	269.44668	0
18	326.66752	0
19	387.15668	0
20	452.18315	0
21	523.61899	0
22	604.47065	1
23	700.15508	1
24	822.32846	1
25	1006.19132	1
26	************	1

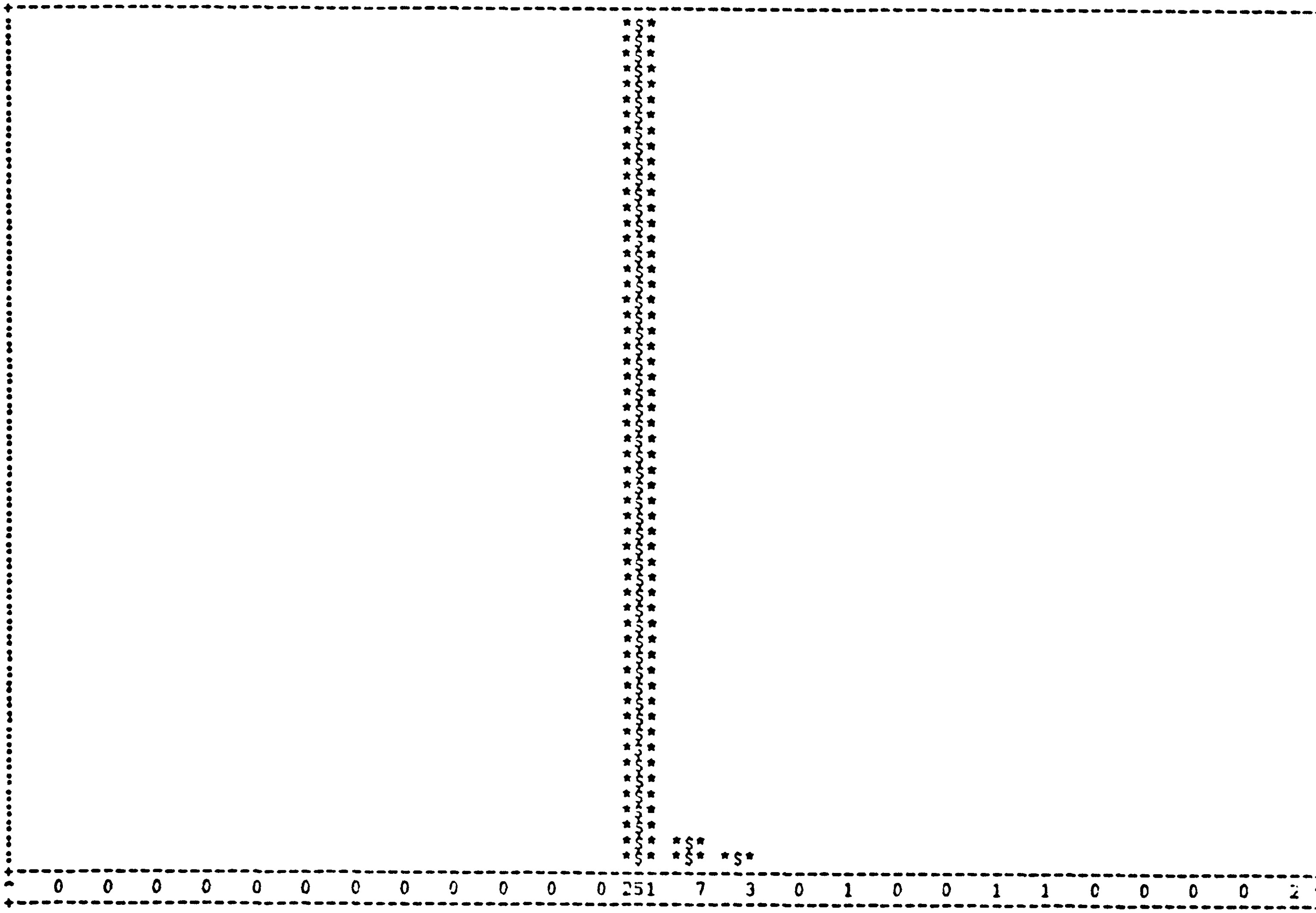
CHI SQUARE = 4613.92479 WITH 24 DEGREES OF FREEDOM

IF CHI SQUARE IS LESS THAN 36.41 THEN WE CAN BE 95%CONFIDENT THAT THE DATA IS NORMALLY DISTRIBUTED

FREQUENCY DISTRIBUTION TABLE

CLASS	UPPER CLASS LIMIT	FREQUENCY	PERCENT OF TOTAL	CUMLATIVE PERCENT
1	-1551.20170	0	0.00	0.00
2	-1417.14450	0	0.00	0.00
3	-1283.08740	0	0.00	0.00
4	-1149.03020	0	0.00	0.00
5	-1014.97300	0	0.00	0.00
6	-880.91578	0	0.00	0.00
7	-746.85859	0	0.00	0.00
8	-612.80140	0	0.00	0.00
9	-478.74421	0	0.00	0.00
10	-344.68702	0	0.00	0.00
11	-210.62983	0	0.00	0.00
12	-76.57264	0	0.00	0.00
13	57.48455	251	94.36	94.36
14	191.54174	7	2.63	96.99
15	325.59893	3	1.13	98.12
16	459.65612	0	0.00	98.12
17	593.71331	1	0.38	98.50
18	727.77050	0	0.00	98.50
19	861.82769	0	0.00	98.50
20	995.88488	1	0.38	98.87
21	1129.94210	1	0.38	99.25
22	1263.99930	0	0.00	99.25
23	1398.05640	0	0.00	99.25
24	1532.11360	0	0.00	99.25
25	1666.17030	0	0.00	99.25
26	************	2	0.75	100.00

TITLE *** BENEDICT THESIS DATA- DSTAT-RAW DATA ***
VARIABLE NUMBER(2) AS



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DISTRIBUTION STATISTICS ROUTINE
TITLE  *** BENEDICT THESIS DATA- DSTAT-RAW DATA                                ***

STATISTICS FOR VARIABLE (  3)  AU
DATA FILE USED = 1
HISTOGRAM CODE =    1
NUMBER OF OBSERVATIONS =                              266
MINIMUM VALUE =                                          0.002000
FIRST QUARTILE =                                         0.002000
SECOND QUARTILE (MEDIAN) =                               0.002000
THIRD QUARTILE =                                         0.007000
MAXIMUM =                                                7.000000
RANGE =                                                  6.998000
MID POINT =                                              3.499000
EMPIRICAL MODE =                                        -0.131504
SUM =                                                   18.288000
MEAN =                                                   0.068752
STANDARD ERROR OF THE MEAN =                             0.031880
FIRST MOMENT ABOUT THE MEAN (SHOULD = 0) =              -0.000000
SECOND MOMENT ABOUT THE MEAN (VARIANCE) =                0.270345
THIRD MOMENT ABOUT THE MEAN =                            1.548487
FOURTH MOMENT ABOUT THE MEAN =                           9.728485
STANDARD DEVIATION =                                     0.519947
MEAN DEVIATION =                                         0.113156
COEFFICIENT OF VARIATION =                             756.265610
BETA1 (MEASURE OF SKEWNESS) =                          121.356011
ALPHA3 (MEASURE OF SKEWNESS) =                          11.016170
STANDARD ERROR FOR SKEWNESS =                            0.150188
PEARSONIAN COEFFICIENT FOR SKEWNESS =                    0.385146
BETA2 (ALPHA4) (KURTOSIS) =                            133.109632
```

CHI SQUARE TEST FOR NORMALLITY

EXPECTED FREQUENCY = 10.23077

CLASS	UPPER CLASS LIMIT	FREQUENCY
1	-0.85115	0
2	-0.67287	0
3	-0.55440	0
4	-0.46163	0
5	-0.38323	0
6	-0.31396	0
7	-0.25091	0
8	-0.19226	0
9	-0.13677	0
10	-0.08357	0
11	-0.03194	0
12	0.01867	206
13	0.06875	25
14	0.11884	9
15	0.16945	2
16	0.22107	3
17	0.27428	0
18	0.32976	1
19	0.38841	0
20	0.45147	0
21	0.52073	1
22	0.59913	1
23	0.69191	1
24	0.81037	1
25	0.98865	1
26	************	1

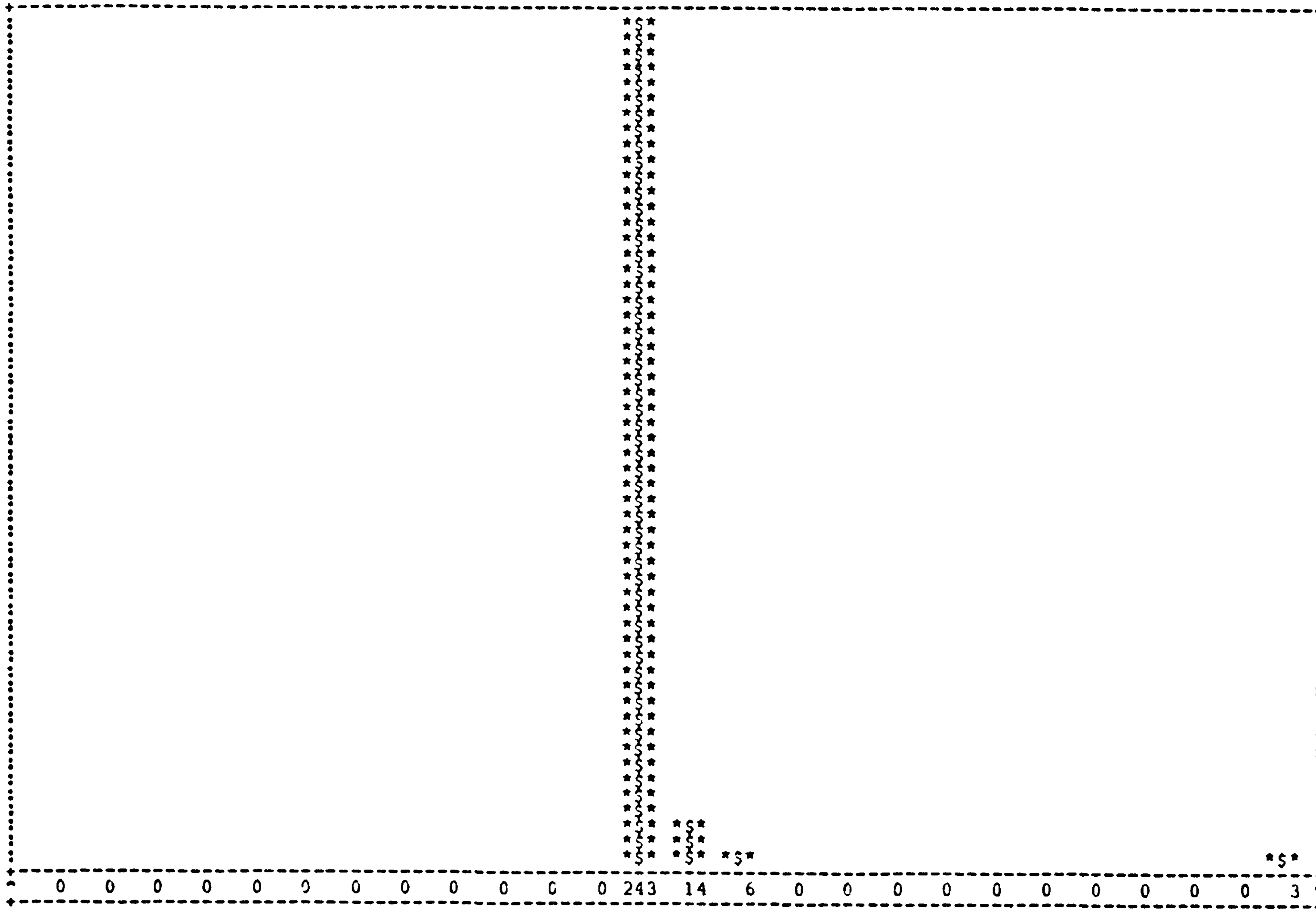
CHI SQUARE = 3980.84209   WITH 24 DEGREES OF FREEDOM

IF CHI SQUARE IS LESS THAN 36.41 THEN WE CAN BE 95%CONFIDENT THAT THE DATA IS NORMALLY DISTRIBUTED

FREQUENCY DISTRIBUTION TABLE

CLASS	UPPER CLASS LIMIT	FREQUENCY	PERCENT OF TOTAL	CUMLATIVE PERCENT
1	-1.49109	0	0.00	0.00
2	-1.36110	0	0.00	0.00
3	-1.23112	0	0.00	0.00
4	-1.10113	0	0.00	0.00
5	-0.97114	0	0.00	0.00
6	-0.84116	0	0.00	0.00
7	-0.71117	0	0.00	0.00
8	-0.58118	0	0.00	0.00
9	-0.45119	0	0.00	0.00
10	-0.32121	0	0.00	0.00
11	-0.19122	0	0.00	0.00
12	-0.06123	0	0.00	0.00
13	0.06875	243	91.35	91.35
14	0.19874	14	5.26	96.62
15	0.32873	6	2.26	98.87
16	0.45871	0	0.00	98.87
17	0.58870	0	0.00	98.87
18	0.71869	0	0.00	98.67
19	0.84867	0	0.00	98.87
20	0.97866	0	0.00	98.87
21	1.10865	0	0.00	98.87
22	1.23863	0	0.00	98.87
23	1.36862	0	0.00	98.87
24	1.49861	0	0.00	98.87
25	1.62859	0	0.00	98.87
26	************	3	1.13	100.00

TITLE *** BENEDICT THESIS DATA- DSTAT-RAW DATA ***
VARIABLE NUMBER(3) AU



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DISTRIBUTION STATISTICS ROUTINE
TITLE  *** BENEDICT THESIS DATA- DSTAT-RAW DATA                                ***

STATISTICS FOR VARIABLE (   4)  BI
DATA FILE USED = 1
HISTOGRAM CODE =    1
NUMBER OF OBSERVATIONS =                              266

MINIMUM VALUE =                                          0.005000
FIRST QUARTILE =                                         0.005000
SECOND QUARTILE (MEDIAN) =                               0.010000
THIRD QUARTILE =                                         0.020000
MAXIMUM =                                               23.000000
RANGE =                                                 22.995000
MID POINT =                                             11.497500
EMPIRICAL MODE =                                        -0.639617
SUM =                                                   89.059000
MEAN =                                                   0.334808
STANDARD ERROR OF THE MEAN =                             0.138303
FIRST MOMENT ABOUT THE MEAN (SHOULD = 0) =               0.000000
SECOND MOMENT ABOUT THE MEAN (VARIANCE) =                5.087949
THIRD MOMENT ABOUT THE MEAN =                          101.867369
FOURTH MOMENT ABOUT THE MEAN =                        2135.839131
STANDARD DEVIATION =                                     2.255648
MEAN DEVIATION =                                         0.581157
COEFFICIENT OF VARIATION =                             673.713402
BETA1 (MEASURE OF SKEWNESS) =                           78.784720
ALPHA3 (MEASURE OF SKEWNESS) =                           8.876076
STANDARD ERROR FOR SKEWNESS =                            0.150188
PEARSONIAN COEFFICIENT FOR SKEWNESS =                    0.431993
BETA2 (ALPHA4) (KURTOSIS) =                             62.505534
```

CHI SQUARE TEST FOR NORMALLITY

EXPECTED FREQUENCY = 10.23077

CLASS	UPPER CLASS LIMIT	FREQUENCY
1	-3.65593	0
2	-2.88251	0
3	-2.36859	0
4	-1.96609	0
5	-1.62599	0
6	-1.32549	0
7	-1.05196	0
8	-0.79751	0
9	-0.55681	0
10	-0.32598	0
11	-0.10202	0
12	0.11753	224
13	0.33481	10
14	0.55209	5
15	0.77164	1
16	0.99560	3
17	1.22643	0
18	1.46713	0
19	1.72158	0
20	1.99511	0
21	2.29560	0
22	2.63571	0
23	3.03820	0
24	3.55213	1
25	4.32555	1
26	************	1

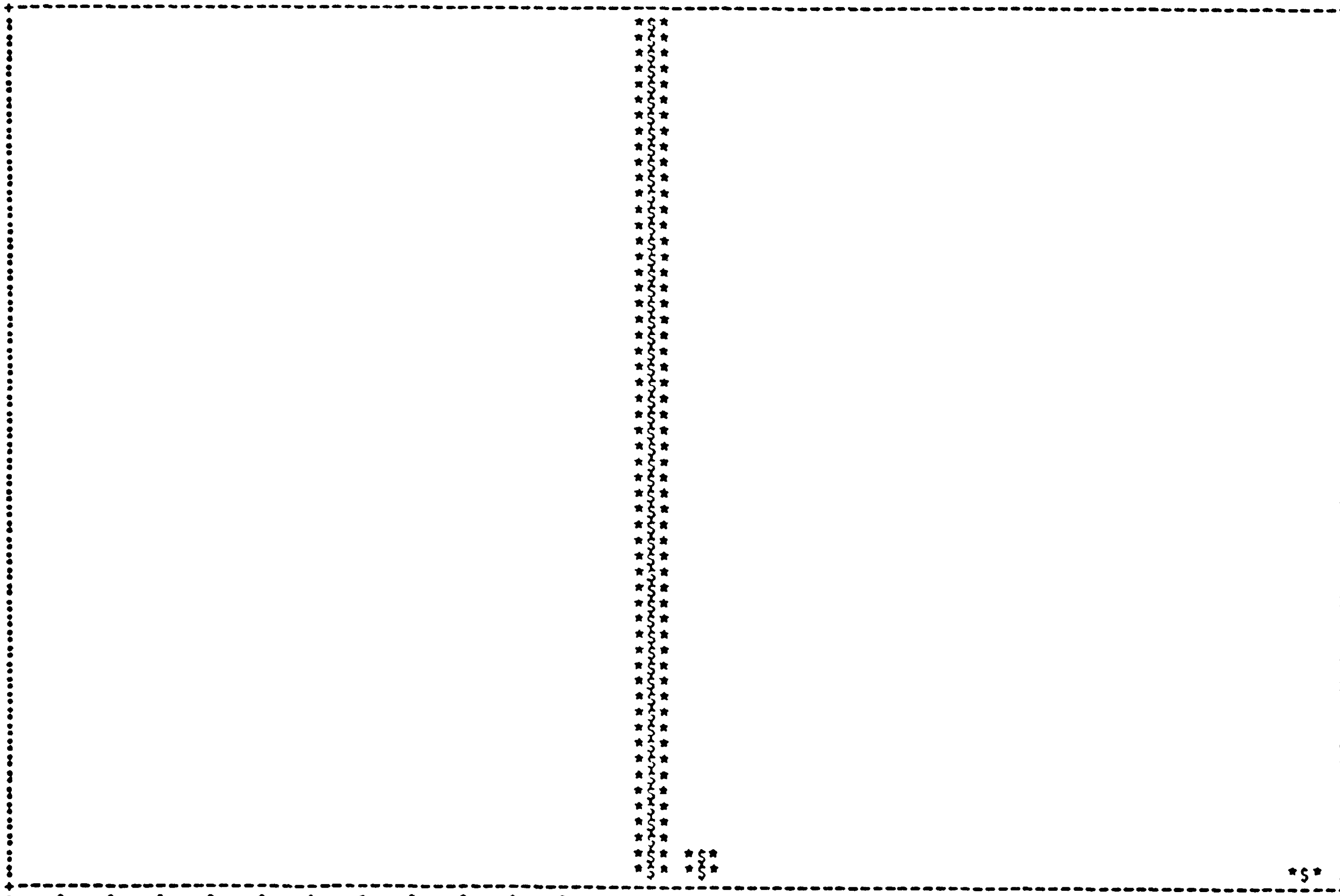
CHI SQUARE = 4691.90975 WITH 24 DEGREES OF FREEDOM

IF CHI SQUARE IS LESS THAN 36.41 THEN WE CAN BE 95%CONFIDENT THAT THE DATA IS NORMALLY DISTRIBUTED

FREQUENCY DISTRIBUTION TABLE

CLASS	UPPER CLASS LIMIT	FREQUENCY	PERCENT OF TOTAL	CUMLATIVE PERCENT
1	-6.43214	0	0.00	0.00
2	-5.86822	0	0.00	0.00
3	-5.30431	0	0.00	0.00
4	-4.74040	0	0.00	0.00
5	-4.17649	0	0.00	0.00
6	-3.61258	0	0.00	0.00
7	-3.04866	0	0.00	0.00
8	-2.48475	0	0.00	0.00
9	-1.92084	0	0.00	0.00
10	-1.35693	0	0.00	0.00
11	-0.79302	0	0.00	0.00
12	-0.22910	0	0.00	0.00
13	0.33481	246	92.48	92.48
14	0.89872	11	4.14	96.62
15	1.46263	2	0.75	97.37
16	2.02654	1	0.38	97.74
17	2.59046	0	0.00	97.74
18	3.15437	0	0.00	97.74
19	3.71828	2	0.75	98.50
20	4.28219	0	0.00	98.50
21	4.84610	1	0.38	98.87
22	5.41002	0	0.00	98.87
23	5.97393	0	0.00	98.87
24	6.53784	0	0.00	98.87
25	7.10175	0	0.00	98.87
26	************	3	1.13	100.00

TITLE *** BENEDICT THESIS DATA- DSTAT-RAW DATA ***
VARIABLE NUMBER(4) BI



0	0	0	0	0	0	0	0	0	0	0	0	246	11	2	1	0	0	2	0	1	0	0	0	0	3

```
DISTRIBUTION STATISTICS ROUTINE
TITLE  *** BENEDICT THESIS DATA- DSTAT-RAW DATA                                    ***

STATISTICS FOR VARIABLE (  5)  SB
DATA FILE USED = 1
HISTOGRAM CODE =   1
NUMBER OF OBSERVATIONS =                         266

MINIMUM VALUE =                                        0.041000
FIRST QUARTILE =                                       0.069000
SECOND QUARTILE (MEDIAN) =                             0.094000
THIRD QUARTILE =                                       0.480000
MAXIMUM =                                            395.000000
RANGE =                                              394.959000
MID POINT =                                          197.479500
EMPIRICAL MODE =                                     -14.833609
SUM =                                               2010.376000
MEAN =                                                 7.557805
STANDARD ERROR OF THE MEAN =                           2.093443
FIRST MOMENT ABOUT THE MEAN (SHOULD = 0) =             0.000000
SECOND MOMENT ABOUT THE MEAN (VARIANCE) =           1165.746056
THIRD MOMENT ABOUT THE MEAN =                     312802.032716
FOURTH MOMENT ABOUT THE MEAN =                  ***************
STANDARD DEVIATION =                                  34.143024
MEAN DEVIATION =                                      12.728115
COEFFICIENT OF VARIATION =                           451.758490
BETA1 (MEASURE OF SKEWNESS) =                         61.762842
ALPHA3 (MEASURE OF SKEWNESS) =                         7.858934
STANDARD ERROR FOR SKEWNESS =                          0.150188
PEARSONIAN COEFFICIENT FOR SKEWNESS =                  0.655812
BETA2 (ALPHA4) (KURTOSIS) =                           76.750844
```

CHI SQUARE TEST FOR NORMALLITY

EXPECTED FREQUENCY = 10.23077

CLASS	UPPER CLASS LIMIT	FREQUENCY
1	-52.84872	0
2	-41.14172	0
3	-33.36263	0
4	-27.27017	0
5	-22.12214	0
6	-17.57364	0
7	-13.43324	0
8	-9.58175	0
9	-5.93835	0
10	-2.44435	0
11	0.94564	199
12	4.26888	24
13	7.55781	4
14	10.84673	0
15	14.16997	3
16	17.55996	0
17	21.05396	2
18	24.69736	0
19	28.54885	0
20	32.68925	0
21	37.23775	0
22	42.38577	0
23	48.47824	0
24	56.25733	2
25	67.96433	0
26	************	7

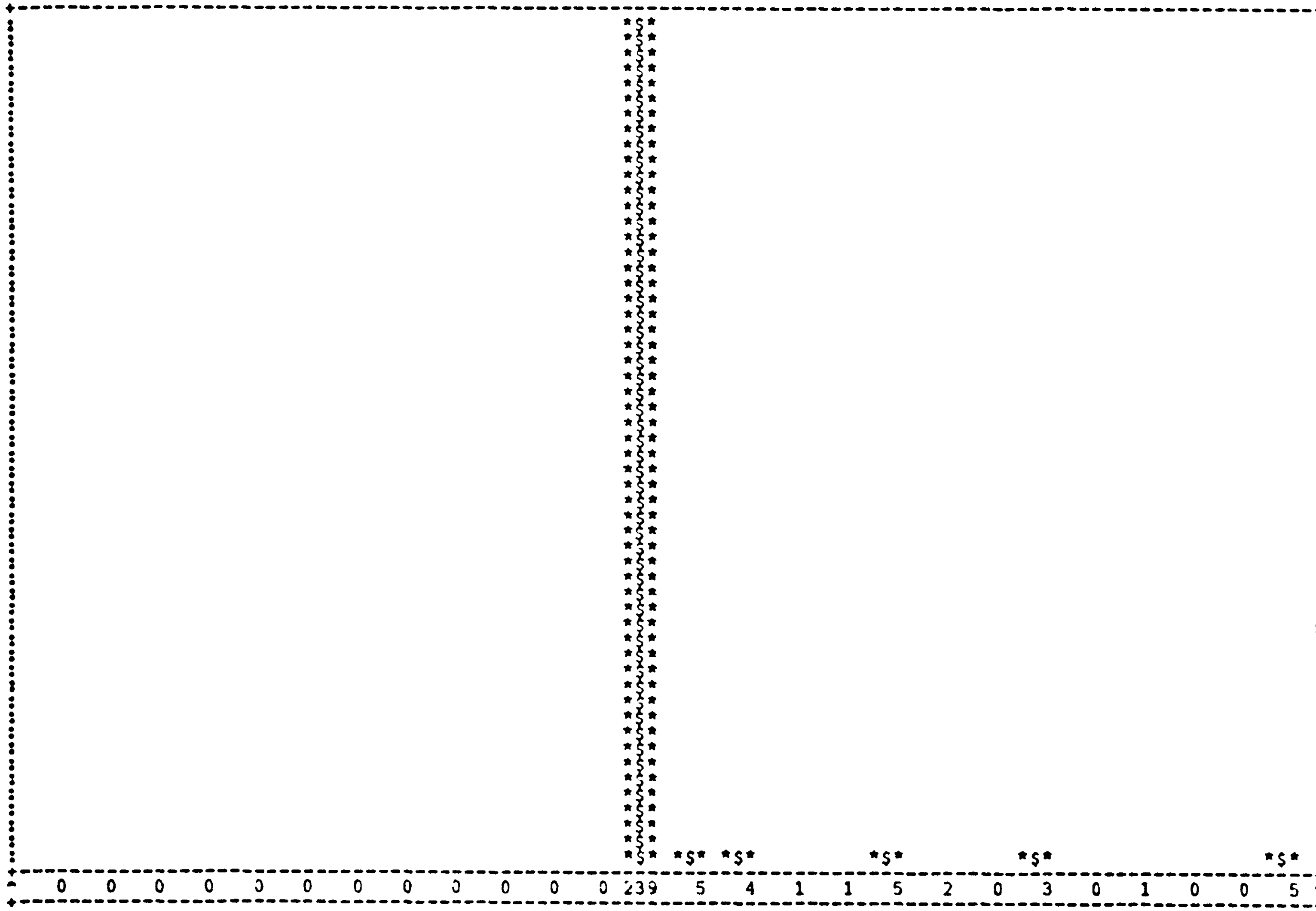
CHI SQUARE = 3719.09021 WITH 24 DEGREES OF FREEDOM

IF CHI SQUARE IS LESS THAN 36.41 THEN WE CAN BE 95%CONFIDENT THAT THE DATA IS NORMALLY DISTRIBUTED

FREQUENCY DISTRIBUTION TABLE

CLASS	UPPER CLASS LIMIT	FREQUENCY	PERCENT OF TOTAL	CUMLATIVE PERCENT
1	-94.87127	0	0.00	0.00
2	-86.33551	0	0.00	0.00
3	-77.79975	0	0.00	0.00
4	-69.26400	0	0.00	0.00
5	-60.72824	0	0.00	0.00
6	-52.19249	0	0.00	0.00
7	-43.65673	0	0.00	0.00
8	-35.12098	0	0.00	0.00
9	-26.58522	0	0.00	0.00
10	-18.04946	0	0.00	0.00
11	-9.51371	0	0.00	0.00
12	-0.97795	0	0.00	0.00
13	7.55780	239	89.85	89.85
14	16.09356	5	1.88	91.73
15	24.62932	4	1.50	93.23
16	33.16507	1	0.38	93.61
17	41.70083	1	0.38	93.98
18	50.23658	5	1.88	95.86
19	58.77234	2	0.75	96.62
20	67.30810	0	0.00	96.62
21	75.84385	3	1.13	97.74
22	84.37961	0	0.00	97.74
23	92.91536	1	0.38	98.12
24	101.45112	0	0.00	98.12
25	109.98688	0	0.00	98.12
26	************	5	1.88	100.00

TITLE *** BENEDICT THESIS DATA- DSTAT-RAW DATA ***
VARIABLE NUMBER(5) SR



DISTRIBUTION STATISTICS ROUTINE
TITLE *** BENEDICT THESIS DATA- DSTAT-RAW DATA

STATISTICS FOR VARIABLE (6) SE
DATA FILE USED = 1
HISTOGRAM CODE = 1

NUMBER OF OBSERVATIONS =	266
MINIMUM VALUE =	0.002000
FIRST QUARTILE =	0.007000
SECOND QUARTILE (MEDIAN) =	0.011000
THIRD QUARTILE =	0.092000
MAXIMUM =	29.000000
RANGE =	28.998000
MID POINT =	14.499000
EMPIRICAL MODE =	-0.888789
SUM =	122.598000
MEAN =	0.460895
STANDARD ERROR OF THE MEAN =	0.130538
FIRST MOMENT ABOUT THE MEAN (SHOULD = 0) =	0.000000
SECOND MOMENT ABOUT THE MEAN (VARIANCE) =	4.532652
THIRD MOMENT ABOUT THE MEAN =	97.738066
FOURTH MOMENT ABOUT THE MEAN =	2588.340601
STANDARD DEVIATION =	2.129003
MEAN DEVIATION =	0.716730
COEFFICIENT OF VARIATION =	461.928182
BETA1 (MEASURE OF SKEWNESS) =	102.581782
ALPHA3 (MEASURE OF SKEWNESS) =	10.128266
STANDARD ERROR FOR SKEWNESS =	0.150188
PEARSONIAN COEFFICIENT FOR SKEWNESS =	0.633951
BETA2 (ALPHA4) (KURTOSIS) =	125.964348

CHI SQUARE TEST FOR NORMALLITY

EXPECTED FREQUENCY = 10.23077

CLASS	UPPER CLASS LIMIT	FREQUENCY
1	-3.30578	0
2	-2.57578	0
3	-2.09072	0
4	-1.71032	0
5	-1.38981	0
6	-1.10619	0
7	-0.84801	0
8	-0.60785	0
9	-0.38066	0
10	-0.16279	0
11	0.04859	177
12	0.25581	31
13	0.46089	7
14	0.66598	8
15	0.87320	2
16	1.09453	3
17	1.30245	0
18	1.52964	2
19	1.76980	2
20	2.02798	3
21	2.31160	1
22	2.63261	0
23	3.01251	0
24	3.49757	0
25	4.22757	1
26	*************	4

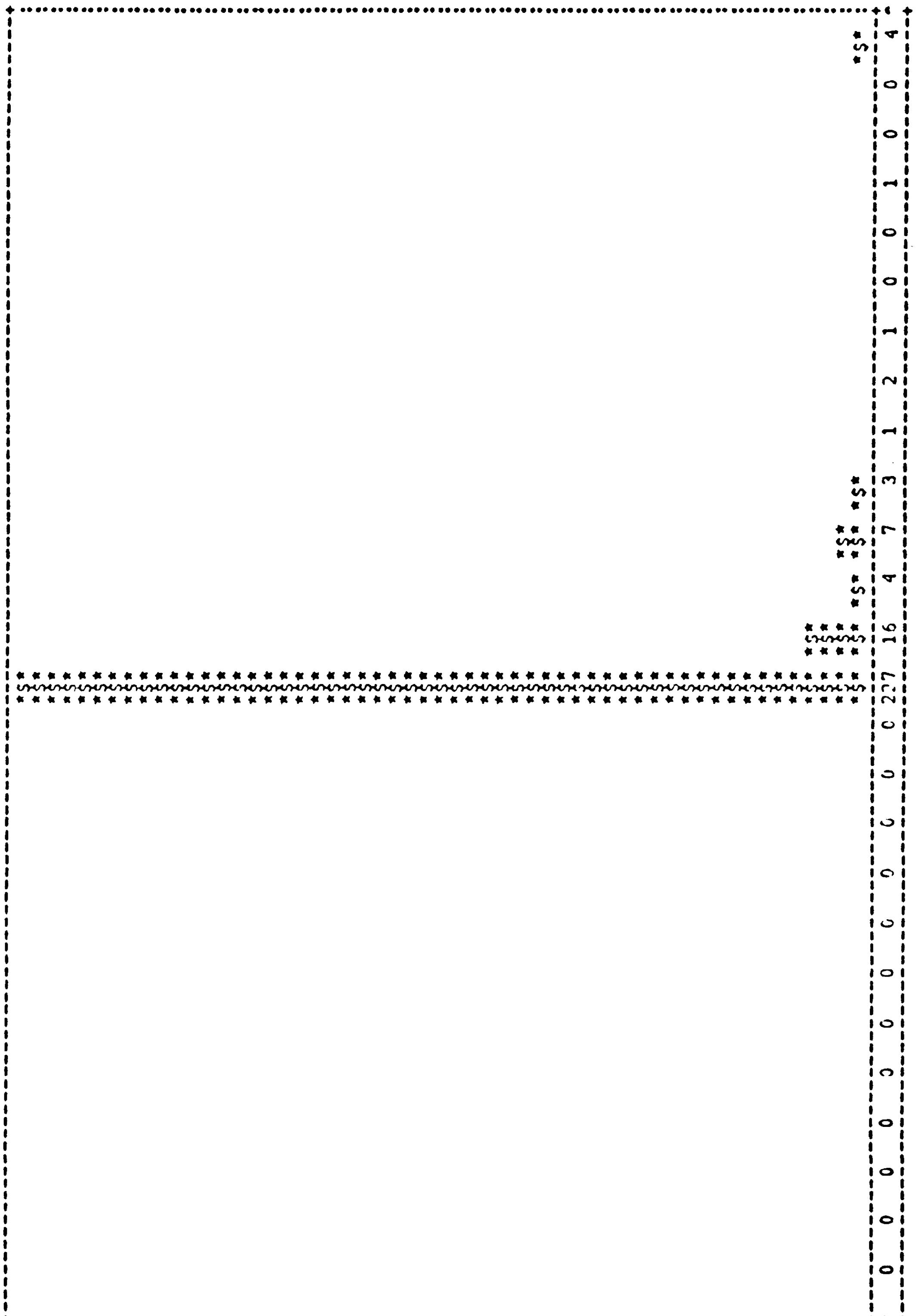
CHI SQUARE = 2955.90224 WITH 24 DEGREES OF FREEDOM

IF CHI SQUARE IS LESS THAN 36.41 THEN WE CAN BE 95%CONFIDENT THAT THE DATA IS NORMALLY DISTRIBUTED

FREQUENCY DISTRIBUTION TABLE

CLASS	UPPER CLASS LIMIT	FREQUENCY	PERCENT OF TOTAL	CUMLATIVE PERCENT
1	-5.92611	0	0.00	0.00
2	-5.39386	0	0.00	0.00
3	-4.86161	0	0.00	0.00
4	-4.32936	0	0.00	0.00
5	-3.79711	0	0.00	0.00
6	-3.26486	0	0.00	0.00
7	-2.73261	0	0.00	0.00
8	-2.20036	0	0.00	0.00
9	-1.66811	0	0.00	0.00
10	-1.13586	0	0.00	0.00
11	-0.60361	0	0.00	0.00
12	-0.07136	0	0.00	0.00
13	0.46089	227	85.34	85.34
14	0.99315	16	6.02	91.35
15	1.52540	4	1.50	92.86
16	2.05765	7	2.63	95.49
17	2.58990	3	1.13	96.62
18	3.12215	1	0.38	96.99
19	3.65440	2	0.75	97.74
20	4.18665	1	0.38	98.12
21	4.71890	0	0.00	98.12
22	5.25115	0	0.00	98.12
23	5.78340	1	0.38	98.50
24	6.31565	0	0.00	98.50
25	6.84790	0	0.00	98.50
26	************	4	1.50	100.00

TITLE *** BENEDICT THESIS DATA- DSTAT-RAW DATA
VARIABLE NUMBER(6) SE



```
DISTRIBUTION STATISTICS ROUTINE
TITLE   *** BENEDICT THESIS DATA- DSTAT-RAW DATA                                                 ***

STATISTICS FOR VARIABLE (   7)  TE
DATA FILE USED = 1
HISTOGRAM CODE =    1
NUMBER OF OBSERVATIONS =                                  266

MINIMUM VALUE =                                              0.001000
FIRST QUARTILE =                                             0.002000
SECOND QUARTILE (MEDIAN) =                                   0.007000
THIRD QUARTILE =                                             0.018000
MAXIMUM =                                                   14.000000
RANGE =                                                     13.999000
MID POINT =                                                  6.999500
EMPIRICAL MODE =                                            -0.332744
SUM =                                                       47.048000
MEAN =                                                       0.176872
STANDARD ERROR OF THE MEAN =                                 0.072651
FIRST MOMENT ABOUT THE MEAN (SHOULD = 0) =                  -0.000000
SECOND MOMENT ABOUT THE MEAN (VARIANCE) =                    1.403989
THIRD MOMENT ABOUT THE MEAN =                               16.684825
FOURTH MOMENT ABOUT THE MEAN =                             213.244259
STANDARD DEVIATION =                                         1.184900
MEAN DEVIATION =                                             0.293699
COEFFICIENT OF VARIATION =                                 669.919035
BETA1 (MEASURE OF SKEWNESS) =                              100.589406
ALPHA3 (MEASURE OF SKEWNESS) =                              10.029427
STANDARD ERROR FOR SKEWNESS =                                0.150188
PEARSONIAN COEFFICIENT FOR SKEWNESS =                        0.430092
BETA2 (ALPHA4) (KURTOSIS) =                                108.180742
```

CHI SQUARE TEST FOR NORMALLITY

EXPECTED FREQUENCY = 10.23077

CLASS	UPPER CLASS LIMIT	FREQUENCY
1	-1.91948	0
2	-1.51320	0
3	-1.24323	0
4	-1.03130	0
5	-0.85314	0
6	-0.69529	0
7	-0.55160	0
8	-0.41794	0
9	-0.29150	0
10	-0.17024	0
11	-0.05260	0
12	0.06273	211
13	0.17687	20
14	0.29101	9
15	0.40634	1
16	0.52399	1
17	0.64524	0
18	0.77168	0
19	0.90535	0
20	1.04903	0
21	1.20689	0
22	1.38554	0
23	1.59698	0
24	1.86694	0
25	2.27322	1
26	************	1

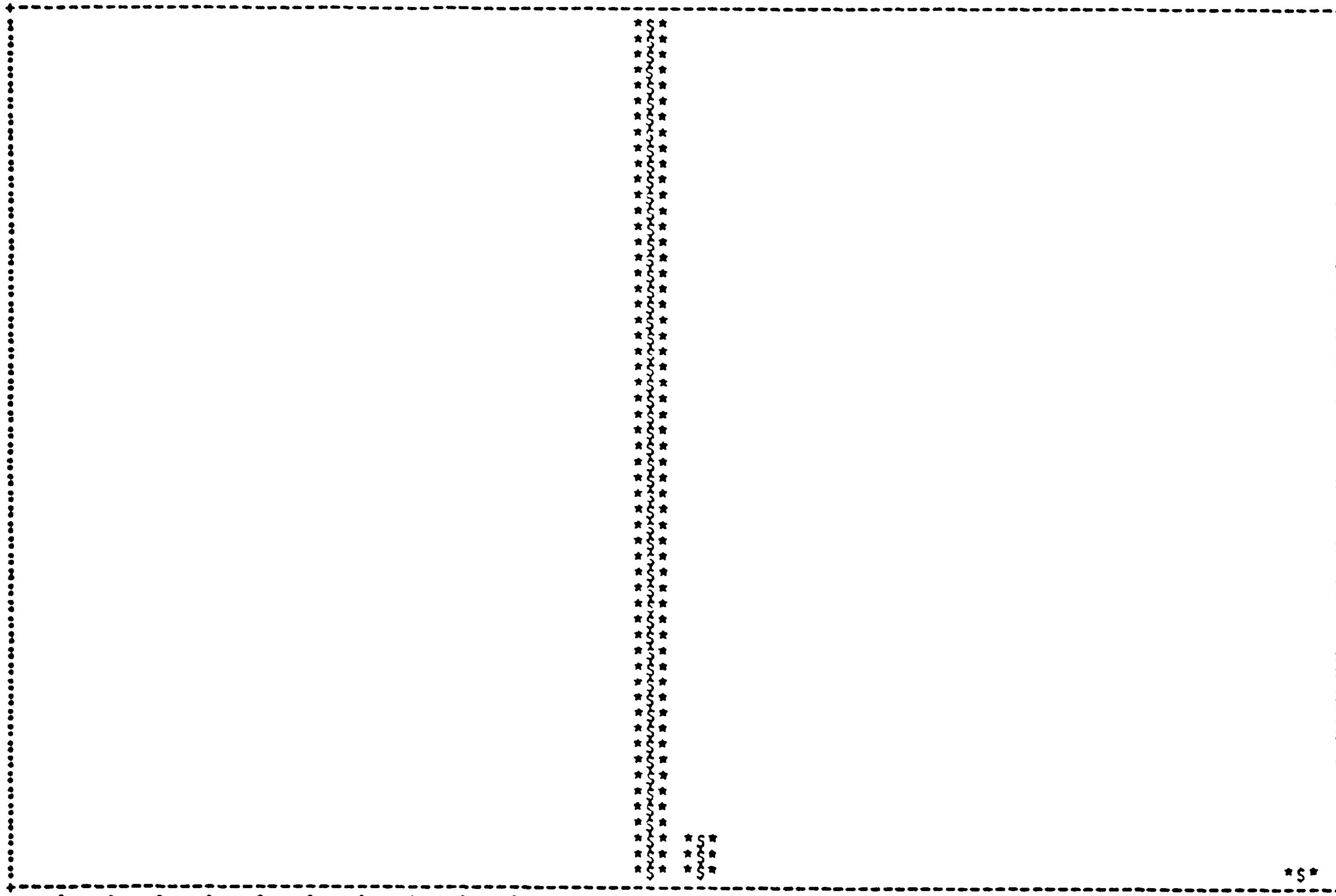
CHI SQUARE = 4177.08269 WITH 24 DEGREES OF FREEDOM

IF CHI SQUARE IS LESS THAN 36.41 THEN WE CAN BE 95%CONFIDENT THAT THE DATA IS NORMALLY DISTRIBUTED

FREQUENCY DISTRIBUTION TABLE

CLASS	UPPER CLASS LIMIT	FREQUENCY	PERCENT OF TOTAL	CUMLATIVE PERCENT
1	-3.37783	0	0.00	0.00
2	-3.08160	0	0.00	0.00
3	-2.78538	0	0.00	0.00
4	-2.48915	0	0.00	0.00
5	-2.19293	0	0.00	0.00
6	-1.89670	0	0.00	0.00
7	-1.60048	0	0.00	0.00
8	-1.30425	0	0.00	0.00
9	-1.00803	0	0.00	0.00
10	-0.71180	0	0.00	0.00
11	-0.41558	0	0.00	0.00
12	-0.11935	0	0.00	0.00
13	0.17687	243	91.35	91.35
14	0.47310	14	5.26	96.62
15	0.76932	2	0.75	97.37
16	1.06555	0	0.00	97.37
17	1.36177	1	0.38	97.74
18	1.65800	1	0.38	98.12
19	1.95422	1	0.38	98.50
20	2.25045	0	0.00	98.50
21	2.54667	1	0.38	98.87
22	2.84290	0	0.00	98.87
23	3.13912	0	0.00	98.87
24	3.43535	0	0.00	98.87
25	3.73157	0	0.00	98.87
26	************	3	1.13	100.00

TITLE *** BENEDICT THESIS DATA- DSTAT-RAW DATA ***
VARIABLE NUMBER(7) TE



0	0	0	0	0	0	0	0	0	0	0	0	243	14	2	0	1	1	1	0	1	0	0	0	0	3

```
DISTRIBUTION STATISTICS ROUTINE
TITLE  *** BENEDICT THESIS DATA- DSTAT-RAW DATA                                    ***

STATISTICS FOR VARIABLE (  8)  TL
DATA FILE USED = 1
HISTOGRAM CODE =   1
NUMBER OF OBSERVATIONS =                       266

MINIMUM VALUE =                                     0.002000
FIRST QUARTILE =                                    0.002000
SECOND QUARTILE (MEDIAN) =                          0.009000
THIRD QUARTILE =                                    0.040000
MAXIMUM =                                           0.350000
RANGE =                                             0.348000
MID POINT =                                         0.174000
EMPIRICAL MODE =                                   -0.037331
SUM =                                               8.556000
MEAN =                                              0.032165
STANDARD ERROR OF THE MEAN =                        0.003099
FIRST MOMENT ABOUT THE MEAN (SHOULD = 0) =          0.000000
SECOND MOMENT ABOUT THE MEAN (VARIANCE) =           0.002554
THIRD MOMENT ABOUT THE MEAN =                       0.000371
FOURTH MOMENT ABOUT THE MEAN =                      0.000088
STANDARD DEVIATION =                                0.050538
MEAN DEVIATION =                                    0.034349
COEFFICIENT OF VARIATION =                        157.118951
BETA1 (MEASURE OF SKEWNESS) =                       8.270579
ALPHA3 (MEASURE OF SKEWNESS) =                      2.875861
STANDARD ERROR FOR SKEWNESS =                       0.150188
PEARSONIAN COEFFICIENT FOR SKEWNESS =               1.375130
BETA2 (ALPHA4) (KURTOSIS) =                        13.483338
```

CHI SQUARE TEST FOR NORMALLITY

EXPECTED FREQUENCY = 10.23077

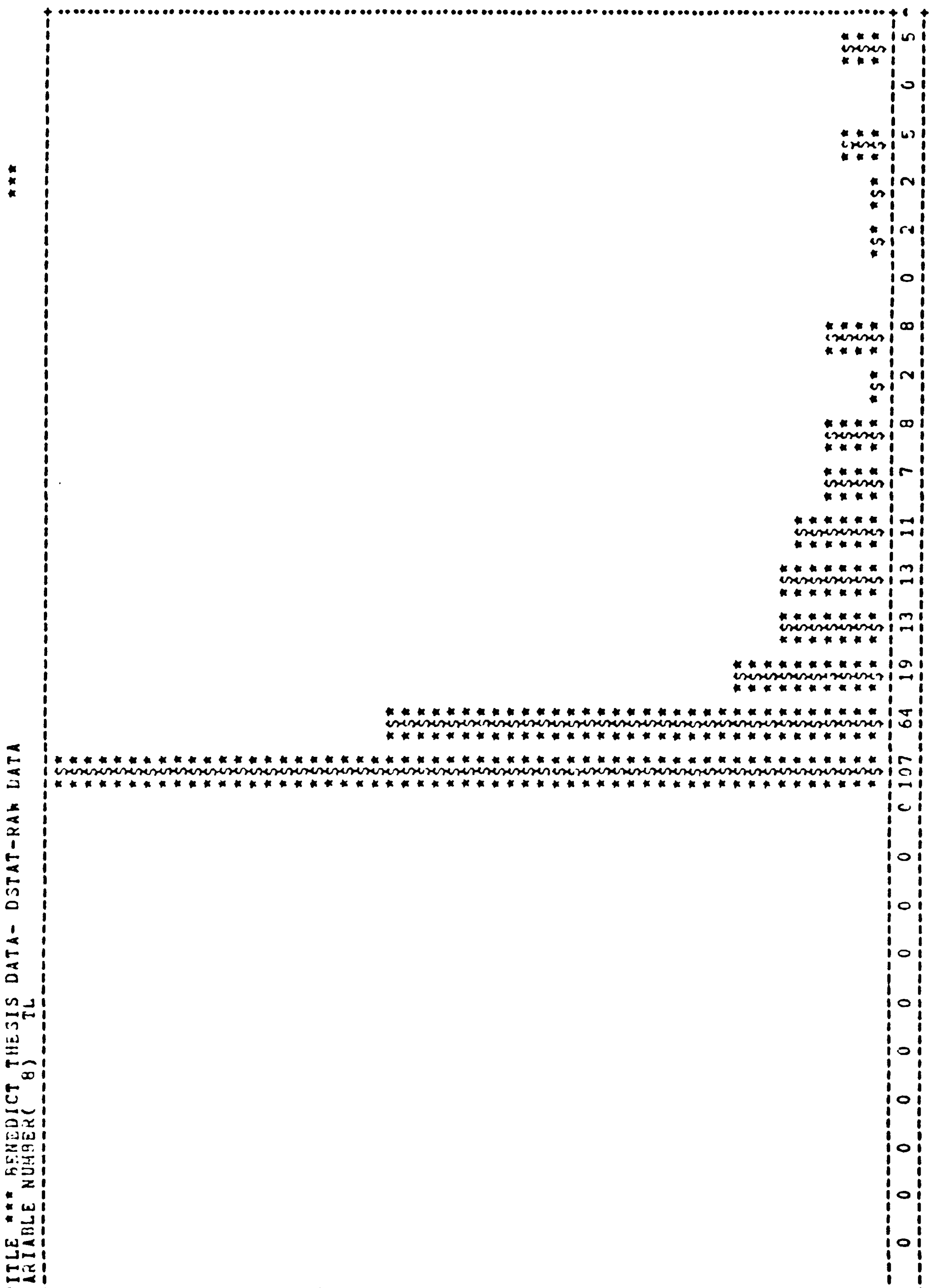
CLASS	UPPER CLASS LIMIT	FREQUENCY
1	-0.05725	0
2	-0.03992	0
3	-0.02840	0
4	-0.01939	0
5	-0.01177	0
6	-0.00503	0
7	0.00109	0
8	0.00680	100
9	0.01219	39
10	0.01736	18
11	0.02238	8
12	0.02730	7
13	0.03217	6
14	0.03703	3
15	0.04195	5
16	0.04697	4
17	0.05214	4
18	0.05754	5
19	0.06324	6
20	0.06936	3
21	0.07610	2
22	0.08372	4
23	0.09274	3
24	0.10425	4
25	0.12158	7
26	************	13

CHI SQUARE = 995.34586 WITH 24 DEGREES OF FREEDOM

IF CHI SQUARE IS LESS THAN 36.41 THEN WE CAN BE 95%CONFIDENT THAT THE DATA IS NORMALLY DISTRIBUTED

FREQUENCY DISTRIBUTION TABLE

CLASS	UPPER CLASS LIMIT	FREQUENCY	PERCENT OF TOTAL	CUMLATIVE PERCENT
1	-0.11945	0	0.00	0.00
2	-0.10681	0	0.00	0.00
3	-0.09418	0	0.00	0.00
4	-0.08154	0	0.00	0.00
5	-0.06891	0	0.00	0.00
6	-0.05628	0	0.00	0.00
7	-0.04364	0	0.00	0.00
8	-0.03101	0	0.00	0.00
9	-0.01837	0	0.00	0.00
10	-0.00574	0	0.00	0.00
11	0.00690	107	40.23	40.23
12	0.01953	64	24.06	64.29
13	0.03217	19	7.14	71.43
14	0.04480	13	4.89	76.32
15	0.05743	13	4.89	81.20
16	0.07007	11	4.14	85.34
17	0.08270	7	2.63	87.97
18	0.09534	8	3.01	90.98
19	0.10797	2	0.75	91.73
20	0.12061	8	3.01	94.74
21	0.13324	0	0.00	94.74
22	0.14588	2	0.75	95.49
23	0.15851	2	0.75	96.24
24	0.17114	5	1.88	98.12
25	0.18378	0	0.00	98.12
26	************	5	1.88	100.00



TITLE *** BENEDICT THESIS DATA- DSTAT-RAW DATA ***
VARIABLE NUMBER(8) TL
0 0 0 0 0 0 0 0 0 C 107 64 19 13 13 11 7 8 2 8 0 2 2 5 0 5

APPENDIX D: ANALYSIS OF VARIANCE DATA

```
DATA RELIABILITY ANALYSIS - BENEDICT THESIS DATA                                      FOR: AG   (LOG-TRANSFORMED)
 MEAN VALUE : -.13903E+01
 ANALYTICAL PRECISIUN :  -45.57 PERCENT
 SAMP.& ANAL. PRECISION : -176.13 PERCENT
 TUTAL VARIANCE : .48313E+00 AND ST.DEV. : .69508E+00

ANALYSIS OF VARIANCE, THREE-LEVEL RANDOM NESTED MODEL :
 BETWEEN STATIONS (REGIONAL EFFECTS)             : .28060E+00 REPRESENTS 58.12 PERCENT, WITH   22 DEGREES OF FREEDOM
 BETWEEN SAMPLES,WITHIN STATIONS (SAMPLING EFF.) : .99934E-01      DITTO 20.68         DITTO   23             DITTO
 BETWEEN REPLICAS,WITHIN SAMPLES,WITHIN STATIONS : .10240E+00      DITTO 21.19         DITTO   46             DITTO

F-TESTS :
 REGIONAL/SAMPLING   :              4.72 WITH   22 AND   23 DEGREES OF FREEDOM
 REGIONAL/ANALYTICAL :             13.92 DITTO  22 AND   46 DITTO
 SAMPLING/ANALYTICAL :              2.95 DITTO  23 AND   46 DITTO
 TOT.VAR./SAMP.&ANAL.PREC. :        3.17 DITTO  91 AND   22 DITTO
```

```
DATA RELIABILITY ANALYSIS - BENEDICT THESIS DATA                                         FOR: AS   (LOG-TRANSFORMED)
MEAN VALUE : -.49240E+00
ANALYTICAL PRECISION :  -88.37 PERCENT
SAMP.& ANAL. PRECISION : -218.10 PERCENT
TOTAL VARIANCE : .41998E+00 AND ST.DEV. : .64806E+00

ANALYSIS OF VARIANCE, THREE-LEVEL RANDOM NESTED MODEL :
BETWEEN STATIONS (REGIONAL EFFECTS)              : .32648E+00 REPRESENTS 77.74 PERCENT, WITH   22 DEGREES OF FREEDOM
BETWEEN SAMPLES,WITHIN STATIONS (SAMPLING EFF.) : .45206E-01      DITTO 10.76          DITTO   23              DITTO
BETWEEN REPLICAS,WITHIN SAMPLES,WITHIN STATIONS : .48296E-01      DITTO 11.50          DITTO   46              DITTO

F-TESTS :
REGIONAL/SAMPLING    :           10.41 WITH   22 AND   23 DEGREES OF FREEDOM
REGIONAL/ANALYTICAL :           29.91 DITTO  22 AND   46 DITTO
SAMPLING/ANALYTICAL :            2.87 DITTO  23 AND   46 DITTO
TOT.VAR./SAMP.&ANAL.PREC. :      1.43 DITTO  91 AND   22 DITTO
```

```
DATA RELIABILITY ANALYSIS - BENEDICT THESIS DATA                                    FOR: AU   (LOG-TRANSFORMED)
MEAN VALUE : -.24995E+01
ANALYTICAL PRECISION :  -21.19 PERCENT
SAMP.& ANAL. PRECISION : -144.45 PERCENT
TOTAL VARIANCE : .21617E+00 AND ST.DEV. : .46494E+00

ANALYSIS OF VARIANCE, THREE-LEVEL RANDOM NESTED MODEL :
 BETWEEN STATIONS (REGIONAL EFFECTS)               : .13251E+00 REPRESENTS 61.30 PERCENT, WITH  22 DEGREES OF FREEDOM
 BETWEEN SAMPLES,WITHIN STATIONS (SAMPLING EFF.) : .12117E-01     DITTO  5.61        DITTO  23               DITTO
 BETWEEN REPLICAS,WITHIN SAMPLES,WITHIN STATIONS : .71545E-01     DITTO 33.10        DITTO  46               DITTO

F-TESTS :
 REGIONAL/SAMPLING    :            12.20 WITH   22 AND   23 DEGREES OF FREEDOM
 REGIONAL/ANALYTICAL :              8.07 DITTO  22 AND   46 DITTO
 SAMPLING/ANALYTICAL :              1.51 DITTO  23 AND   46 DITTO
 TOT.VAR./SAMP.&ANAL.PREC. :       15.38 DITTO  91 AND   22 DITTO
```

```
DATA RELIABILITY ANALYSIS - BENEDICT THESIS DATA                              FOR: BI   (LOG-TRANSFORMED)
MEAN VALUE : -.20112E+01
ANALYTICAL PRECISION :  -23.93 PERCENT
SAMP.& ANAL. PRECISION : -133.62 PERCENT
TOTAL VARIANCE : .74404E-01 AND ST.DEV. : .27277E+00

ANALYSIS OF VARIANCE, THREE-LEVEL RANDOM NESTED MODEL :
 BETWEEN STATIONS (REGIONAL EFFECTS)             : .10531E-02 REPRESENTS  1.42 PERCENT, WITH   22 DEGREES OF FREEDOM
 BETWEEN SAMPLES,WITHIN STATIONS (SAMPLING EFF.) : .14284E-01      DITTO 19.20         DITTO   23              DITTO
 BETWEEN REPLICAS,WITHIN SAMPLES,WITHIN STATIONS : .59066E-01      DITTO 79.39         DITTO   46              DITTO

F-TESTS :
 REGIONAL/SAMPLING   :              1.05 WITH   22 AND   23 DEGREES OF FREEDOM
 REGIONAL/ANALYTICAL :              1.41 DITTO  22 AND   46 DITTO
 SAMPLING/ANALYTICAL :              1.48 DITTO  23 AND   46 DITTO
 TOT.VAR./SAMP.&ANAL.PREC. :       24.76 DITTO  91 AND   22 DITTO
```

```
DATA RELIABILITY ANALYSIS - BENEDICT THESIS DATA                                    FOR:  SB   (LOG-TRANSFORMED)
 MEAN VALUE : -.95192E+00
 ANALYTICAL PRECISION :  -47.80 PERCENT
 SAMP.& ANAL. PRECISION : -143.57 PERCENT
 TOTAL VARIANCE : .20332E+00 AND ST.DEV. : .45091E+00

ANALYSIS OF VARIANCE, THREE-LEVEL RANDOM NESTED MODEL :
 BETWEEN STATIONS (REGIONAL EFFECTS)              : .12609E+00 REPRESENTS 62.01 PERCENT, WITH   22 DEGREES OF FREEDOM
 BETWEEN SAMPLES,WITHIN STATIONS (SAMPLING EFF.) : .24414E-01      DITTO 12.01          DITTO   23              DITTO
 BETWEEN REPLICAS,WITHIN SAMPLES,WITHIN STATIONS : .52818E-01      DITTO 25.98          DITTO   46              DITTO

F-TESTS :
 REGIONAL/SAMPLING   :          127.41 WITH   22 AND   23 DEGREES OF FREEDOM
 REGIONAL/ANALYTICAL :            9.62 DITTO  22 AND   46 DITTO
 SAMPLING/ANALYTICAL :           13.24 DITTO  23 AND   46 DITTO
 TOT.VAR./SAMP.&ANAL.PREC. :      2.34 DITTO  91 AND   22 DITTO
```

```
DATA RELIABILITY ANALYSIS - BENEDICT THESIS DATA                                          FOR:  SE   (LOG-TRANSFORMED)
MEAN VALUE : -.18129E+01
ANALYTICAL PRECISION :  -25.58 PERCENT
SAMP.& ANAL. PRECISION : -156.64 PERCENT
TOTAL VARIANCE : .48821E+00 AND ST.DEV. : .69872E+00

ANALYSIS OF VARIANCE, THREE-LEVEL RANDOM NESTED MODEL :
BETWEEN STATIONS (REGIONAL EFFECTS)             : .39941E+00 REPRESENTS 81.81 PERCENT, WITH   22 DEGREES OF FREEDOM
BETWEEN SAMPLES,WITHIN STATIONS (SAMPLING EFF.) : .33956E-01      DITTO  6.96         DITTO   23              DITTO
BETWEEN REPLICAS,WITHIN SAMPLES,WITHIN STATIONS : .54843E-01      DITTO 11.23         DITTO   46              DITTO

F-TESTS :
REGIONAL/SAMPLING   :            14.01 WITH   22 AND   23 DEGREES OF FREEDOM
REGIONAL/ANALYTICAL :            31.37 DITTO  22 AND   46 DITTO
SAMPLING/ANALYTICAL :             2.24 DITTO  23 AND   46 DITTO
TOT.VAR./SAMP.&ANAL.PREC. :       4.21 DITTO  91 AND   22 DITTO
```

```
DATA RELIABILITY ANALYSIS - BENEDICT THESIS DATA                                   FOR: TE   (LOG-TRANSFORMED)
 MEAN VALUE : -.22701E+01
 ANALYTICAL PRECISION :  -43.61 PERCENT
 SAMP.& ANAL. PRECISION : -155.35 PERCENT
 TOTAL VARIANCE : .29464E+00 AND ST.DEV. : .54281E+00

ANALYSIS OF VARIANCE, THREE-LEVEL RANDOM NESTED MODEL :
 BETWEEN STATIONS (REGIONAL EFFECTS)            : .34468E-01 REPRESENTS 11.70 PERCENT, WITH   22 DEGREES OF FREEDOM
 BETWEEN SAMPLES,WITHIN STATIONS (SAMPLING EFF.) : .10180E-01      DITTO  3.46         DITTO   23              DITTO
 BETWEEN REPLICAS,WITHIN SAMPLES,WITHIN STATIONS : .24999E+00      DITTO 84.85         DITTO   46              DITTO

F-TESTS :
 REGIONAL/SAMPLING   :               1.60 WITH   22 AND   23 DEGREES OF FREEDOM
 REGIONAL/ANALYTICAL :               1.47 DITTO  22 AND   46 DITTO
 SAMPLING/ANALYTICAL :               1.09 DITTO  23 AND   46 DITTO
 TOT.VAR./SAMP.&ANAL.PREC. :        10.77 DITTO  91 AND   22 DITTO
```

```
DATA RELIABILITY ANALYSIS - BENEDICT THESIS DATA                                     FOR: TL   (LOG-TRANSFORMED)
MEAN VALUE : -.20187E+01
ANALYTICAL PRECISION :  -21.59 PERCENT
SAMP.& ANAL. PRECISION : -150.61 PERCENT
TOTAL VARIANCE : .42543E+00 AND ST.DEV. : .65225E+00

ANALYSIS OF VARIANCE, THREE-LEVEL RANDOM NESTED MODEL :
BETWEEN STATIONS (REGIONAL EFFECTS)             : .31028E+00 REPRESENTS 72.93 PERCENT, WITH   22 DEGREES OF FREEDOM
BETWEEN SAMPLES,WITHIN STATIONS (SAMPLING EFF.) : .66694E-01      DITTO 15.68        DITTO   23             DITTO
BETWEEN REPLICAS,WITHIN SAMPLES,WITHIN STATIONS : .48457E-01      DITTO 11.39        DITTO   46             DITTO

F-TESTS :
REGIONAL/SAMPLING   :            7.83 WITH   22 AND   23 DEGREES OF FREEDOM
REGIONAL/ANALYTICAL :           29.37 DITTO  22 AND   46 DITTO
SAMPLING/ANALYTICAL :            3.75 DITTO  23 AND   46 DITTO
TOT.VAR./SAMP.&ANAL.PREC. :      5.54 DITTO  91 AND   22 DITTO
```

APPENDIX E: CORRELATION ANALYSIS DATA

CORRELATION ANALYSIS ROUTINE

TITLE *** BENEDICT THESIS DATA- CORLAT-LOG 10 DATA ***

NUMBER OF OBSERVATIONS = 266

NUMBER OF VARIABLES = 8

DATA FILE USED = 2

OUTPUT OPTION CODE = 0

VARIABLE	NUMBER	MEAN	STANDARD DEVIATION
AG	1	-1.3930985	0.8452252
AS	2	-0.3497241	0.9803129
AU	3	-2.3275427	0.6646484
DI	4	-1.8028105	0.6961547
SB	5	-0.5650136	0.9089375
SE	6	-1.5573078	0.9117588
TE	7	-2.0580026	0.8182847
TL	8	-1.9409646	0.6412031

CORRELATION MATRIX

	AG (1)	AS (2)	AU (3)	BI (4)	SB (5)	SE (6)	TE (7)	TL (8)
AG (1)	1.00000							
AS (2)	0.52467	1.00000						
AU (3)	0.51058	0.40145	1.00000					
BI (4)	0.37696	0.48800	0.30958	1.00000				
SB (5)	0.53743	0.73705	0.50473	0.50810	1.00000			
SE (6)	0.30247	0.46114	0.42390	0.55863	0.65003	1.00000		
TE (7)	0.27522	0.36111	0.30865	0.56766	0.46800	0.65960	1.00000	
TL (8)	0.23641	0.18494	0.16263	0.17591	0.24829	0.17435	0.03825	1.00000

MATRIX OF STUDENT'S T CORRELATION COEFFICIENTS

	AG (1)	AS (2)	AU (3)	BI (4)	SB (5)	SE (6)	TE (7)	TL (8)
AG (1)	0.00000							
AS (2)	10.01399	0.00000						
AU (3)	9.64845	7.12196	0.00000					
BI (4)	6.61279	9.08407	5.29004	0.00000				
SB (5)	10.35468	17.71961	9.49979	9.58523	0.00000			
SE (6)	5.15608	8.44404	7.60464	10.94345	13.89833	0.00000		
TE (7)	4.65135	6.29193	5.27240	11.20336	8.60460	14.25892	0.00000	
TL (8)	3.95324	3.05769	2.67804	2.90349	4.16459	2.87698	0.62193	0.00000

DEGREES OF FREEDOM = 264

95% SIGNIFICANCE LEVEL OF STUDENT'S T IS 1.64

PROBABILITY MATRIX OF STUDENT'S T COEFFICIENTS

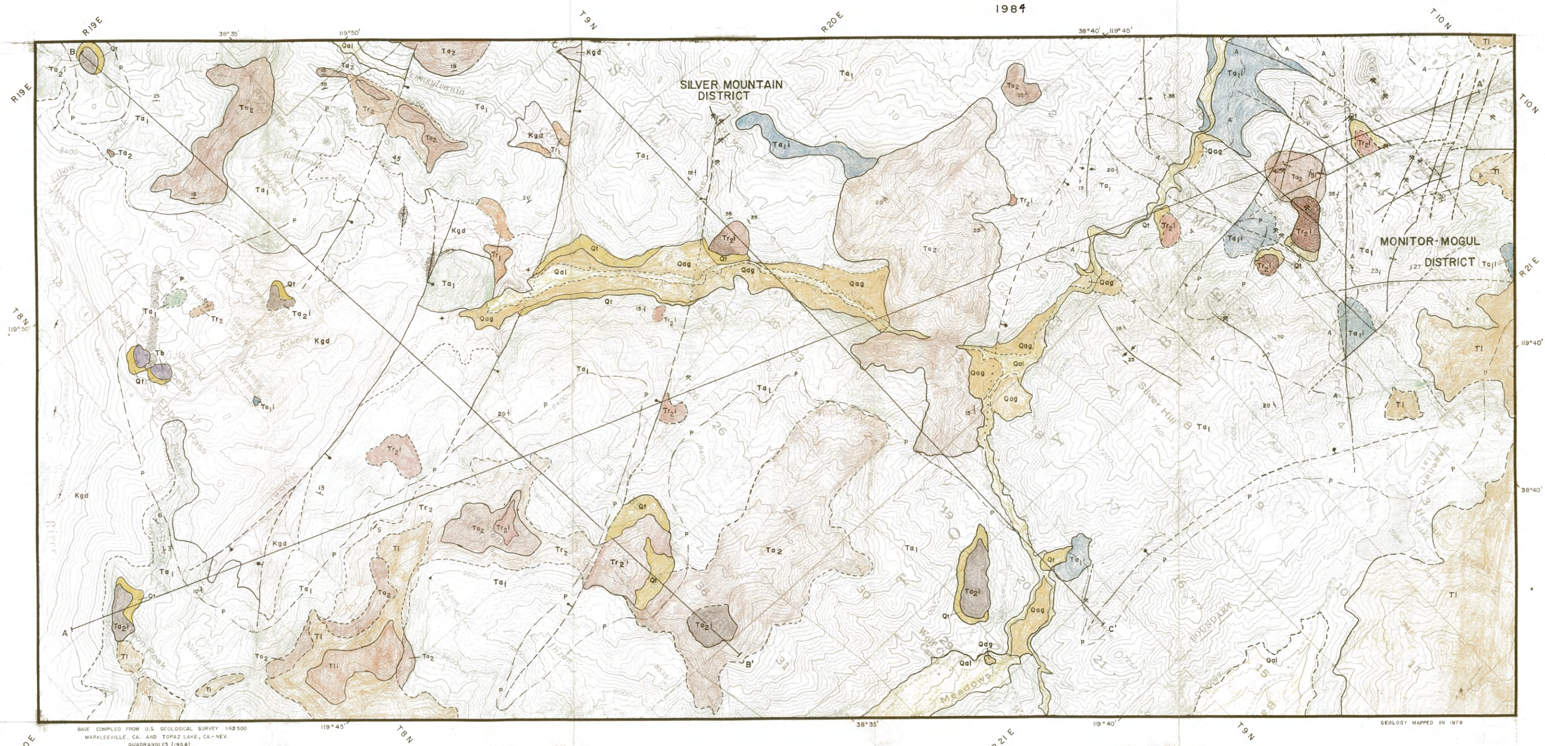
	AG (1)	AS (2)	AU (3)	BI (4)	SB (5)	SE (6)	TE (7)	TL (8)
AG (1)	1.00000							
AS (2)	1.00000	1.00000						
AU (3)	1.00000	1.00000	1.00000					
BI (4)	1.00000	1.00000	1.00000	1.00000				
SB (5)	1.00000	1.00000	1.00000	1.00000	1.00000			
SE (6)	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000		
TE (7)	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	
TL (8)	0.99995	0.99877	0.99607	0.99800	0.99998	0.99783	0.73274	1.00000

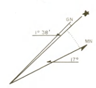
$$$$$ ALL RUNS COMPLETED $$$$$

PLATE I
T-2262

GEOLOGIC MAP OF EAST-CENTRAL ALPINE COUNTY, CALIFORNIA

F.C. BENEDICT, Jr.
1984





HORIZONTAL AND VERTICAL
SCALE 1:24,000
CONTOUR INTERVAL 80 FEET
DATUM IS MEAN SEA LEVEL

MAP LOCATION

EXPLANATION

CORRELATION OF MAP UNITS

Qal, Qt	Holocene	QUATERNARY
unconformity		
Qag	Pleistocene	QUATERNARY
unconformity		
Tr2, Tb, Ta2, Ta2i, Tl, Tli	Pliocene	TERTIARY
unconformity		
Ta1, Ta1i	Miocene	TERTIARY
unconformity		
Tr1	Oligocene	TERTIARY
unconformity		
Kgd		CRETACEOUS

DESCRIPTION OF MAP UNITS

Qal — MODERN ALLUVIUM. unconsolidated or semi-consolidated sediments and reworked glacial material.

Qt — MODERN TALUS. accumulation of coarse, typically angular, debris at the base of steep slopes.

Qag — GLACIAL DEPOSITS. predominantly poorly sorted till.

Tb — BASALT EXTRUSIVE. olive black, massive olivine basalt, exhibiting moderately well developed jointing.

Tr2 — YOUNGER FELSIC EXTRUSIVES. very light grey to pinkish grey, dacitic tuffaceous rocks with late rhyolitic exogenous flow dome complexes. Typically biotite bearing.

Tr2i — YOUNGER FELSIC INTRUSIVES. pale red to very light grey, flow banded porphyritic biotite rhyolites and rhyodacites to fine grained massive biotite granite.

Ta2 — YOUNGER EXTRUSIVE ANDESITES. very light grey to medium light grey porphyritic aphanitic hornblend rich andesite flows, breccias and pale brown to greyish olive massive laharic deposits.

Ta2i — YOUNGER INTRUSIVE ANDESITES. light bluish grey to medium bluish grey porphrytic aphanitic hornblend rich andesite.

Tl — EXTRUSIVE LATITE. light olive grey to medium grey porphyritic aphanitic biotite augite latite and quartz latite.

Tli — INTRUSIVE LATITE. medium light grey porphyritic aphanitic biotite hornblend (after pyroxene) quartz latite.

Ta1 — OLDER EXTRUSIVE ANDESITES. greyish red to greyish yellow green to dark greenish grey intercalated augite bearing flows, tuffs, breccias mudflows and volcanic sediments.

Ta1i — OLDER INTRUSIVE ANDESITES. dark grey to dark greenish grey aphanitic to porphyritic aphanitic to medium grained phaneritic augite bearing andesite to diorite.

Tr1 — OLDER FELSIC EXTRUSIVES. very pale green to greyish yellow green non welded fine grained massive rhyolite crystal lithic tuff.

Kgd — BASEMENT. very light grey to light grey medium grained hypidiomorphic granular biotite hornblend granodiorite.

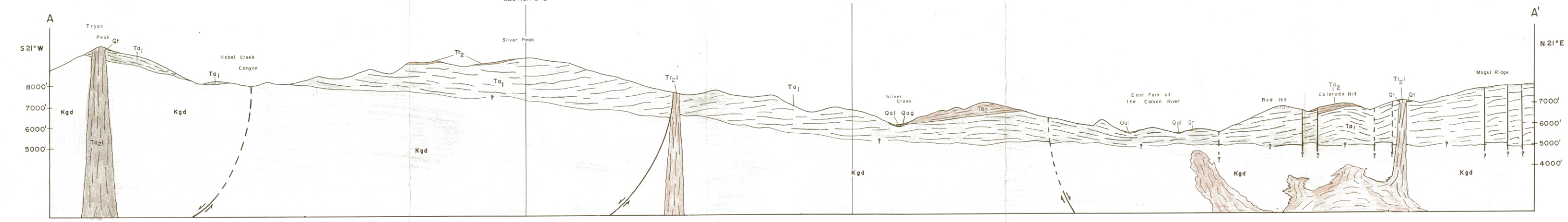
HYDROTHERMAL ROCK ALTERATION PATTERNS

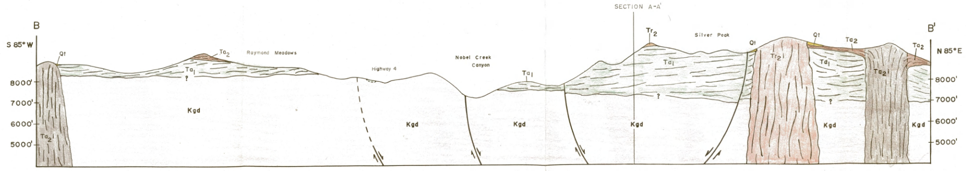
SERICITIC ASSEMBLAGE- characterized by quartz, sericite, and pyrite.

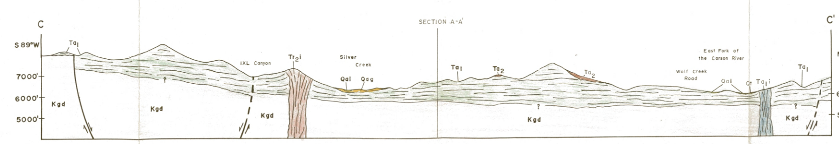
ARGILLIC ASSEMBLAGE- characterized by kaolinite and/or montmorillonite group clays and quartz.

PROPYLITIC ASSEMBLAGE- characterized by albite, epidote, chlorite, and calcite with or without pyrite.

SILICIFIED ZONES- including opaline coatings, chalcedonic veinlets, and dense quartzose masses.







GEOLOGIC SYMBOLS

CONTACT, dashed where approximately located, dotted where concealed

FAULT or FRACTURE, dashed where approximately located, dotted where concealed, ball and bar on down thrown side where known

ANTICLINE, showing trace of axial surface

SYNCLINE, showing trace of axial surface

13° STRIKE and DIP of lava flows

55° INCLINED, VERTICAL STRIKE and DIP of joints

MINE or PROSPECT

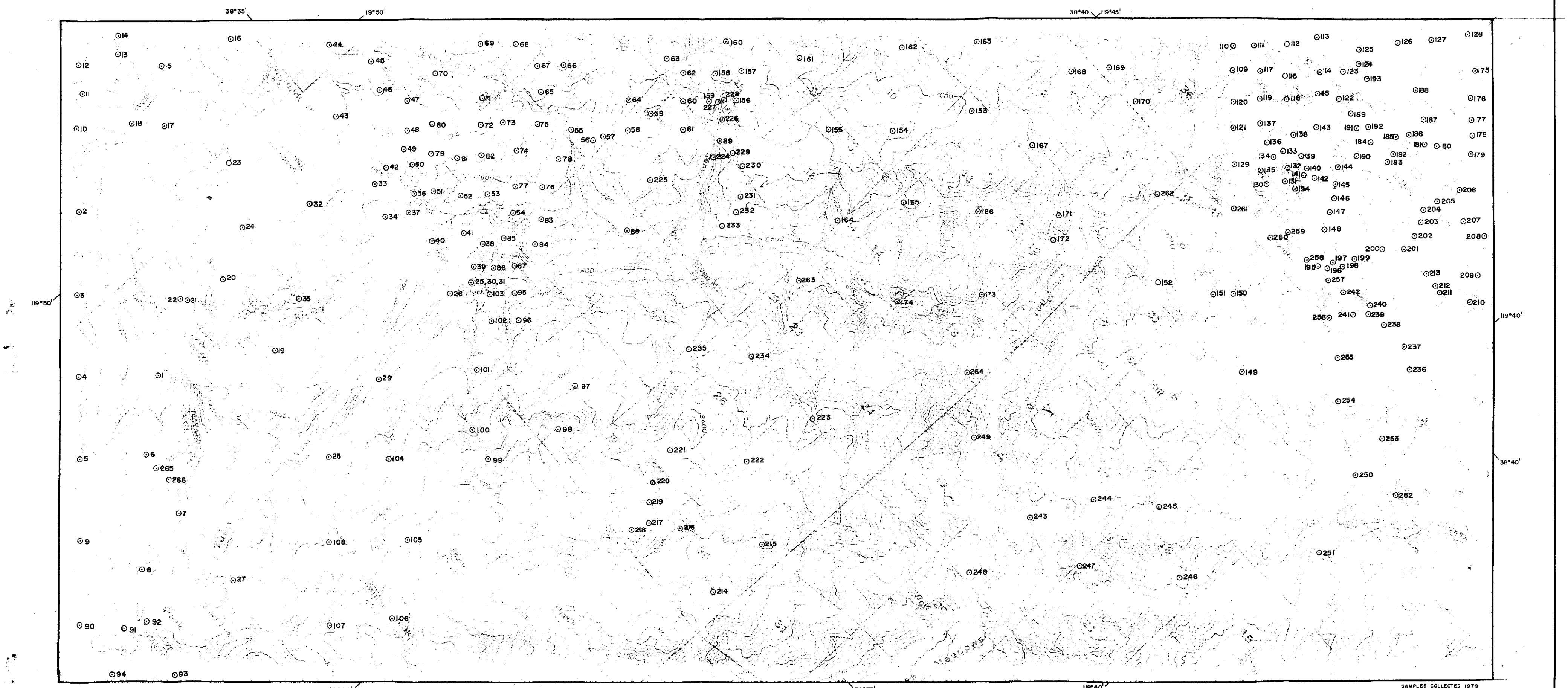
A — A' CROSS SECTION LINE

PLATE 2
T-2262

LITHOGEOCHEMICAL SAMPLE SITE LOCATION MAP EAST-CENTRAL ALPINE Co., CA.

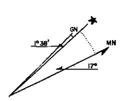
F.C. BENEDICT, Jr.

1984

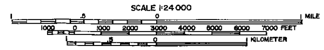


SAMPLES COLLECTED 1979

BASE COMPILED FROM U.S. GEOLOGICAL SURVEY 1:62 500
MARKLEEVILLE, CA. AND TOPAZ LAKE, CA.-NEV.
QUADRANGLES (1956).



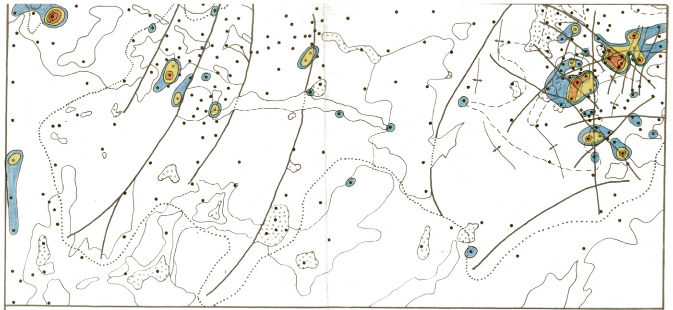
HORIZONTAL
SCALE 1:24 000



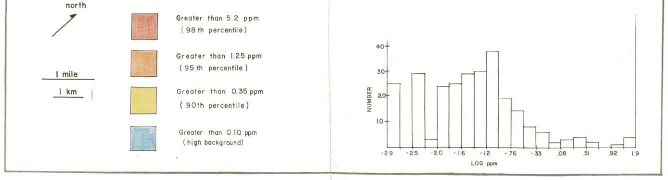
CONTOUR INTERVAL 80 FEET
DATUM IS MEAN SEA LEVEL

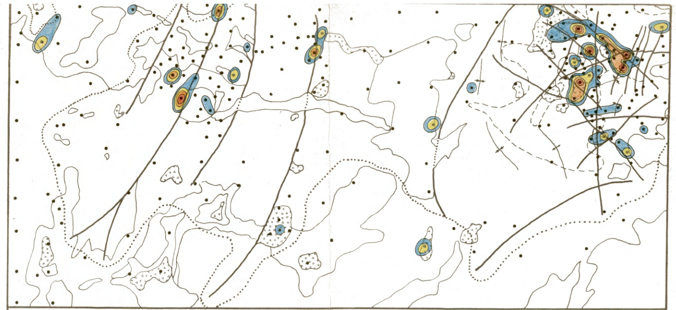
MAP LOCATION

⊙ 251 SAMPLE NUMBER AND SITE LOCATION

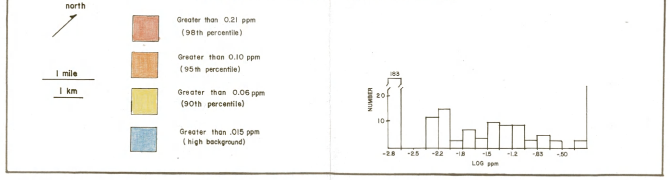


REGIONAL SILVER DISTRIBUTION

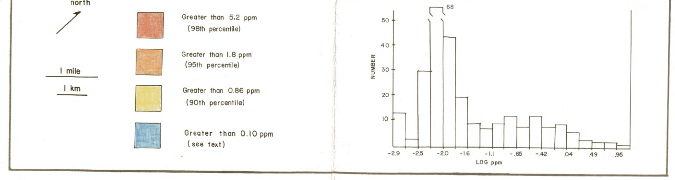


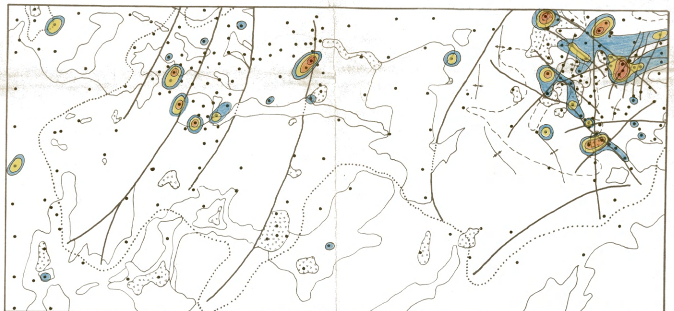


REGIONAL GOLD DISTRIBUTION

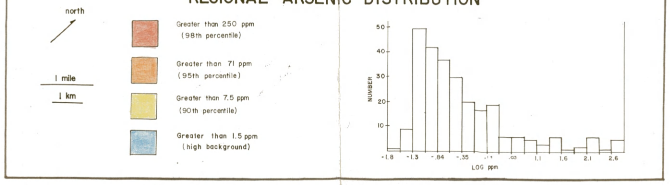


REGIONAL SELENIUM DISTRIBUTION

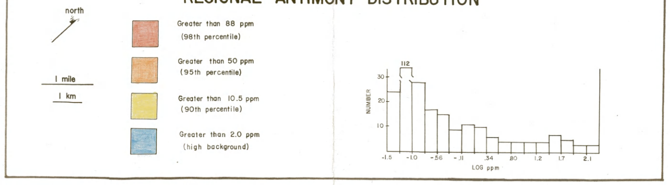


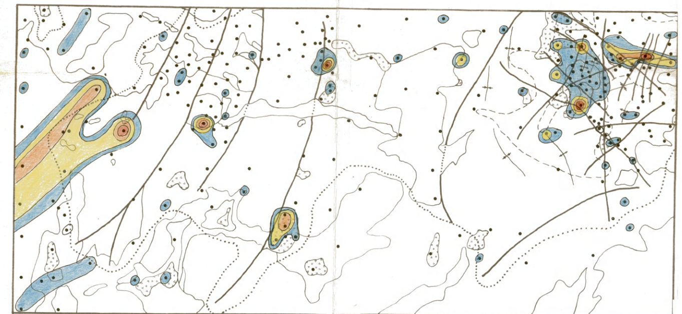


REGIONAL ARSENIC DISTRIBUTION

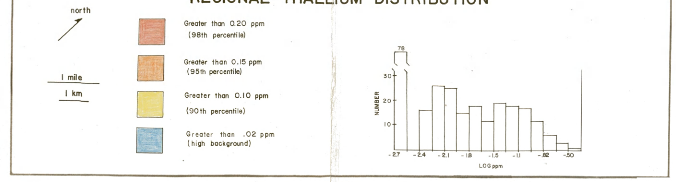


REGIONAL ANTIMONY DISTRIBUTION

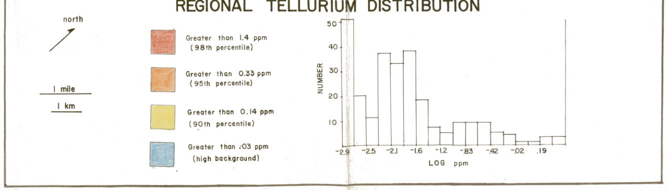


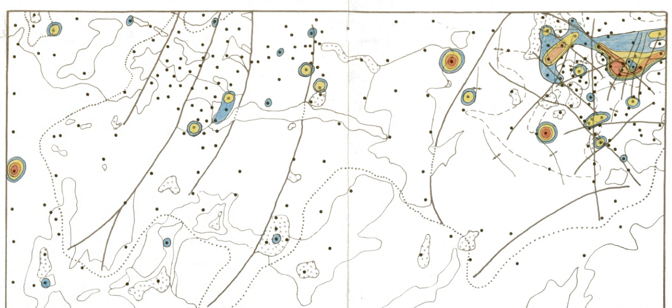


REGIONAL THALLIUM DISTRIBUTION

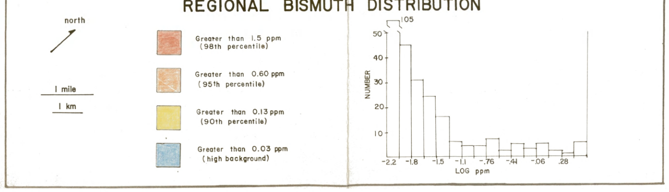


REGIONAL TELLURIUM DISTRIBUTION





REGIONAL BISMUTH DISTRIBUTION



TRACE ELEMENT DISTRIBUTION, EAST - CENTRAL ALPINE COUNTY, CALIFORNIA

• SAMPLE SITE LOCATIONS (for numeration see PLATE 2)

DATA CONTOURED AS SHOWN

DISTRIBUTION PROFILES CONSTRUCTED USING LOG_{10} TRANSFORMED DATA

ANALYSES PERFORMED 1979-1980

FOR EXPLANATION OF GEOLOGY, SEE PLATE I

GEOCHEMICAL DATA INCLUDED AS APPENDIX A

F.C. BENEDICT, Jr.
1984

PLATE 3
T-2262