Prepared for the U. S. Department of Energy
Assistant Secretary for Resource Applications
Grand Junction Office, Colorado

DPST-79-146-13

WALKER LAKE 1° x 2° NTMS AREA CALIFORNIA AND NEVADA

DATA REPORT

NATIONAL URANIUM RESOURCE EVALUATION PROGRAM

HYDROGEOCHEMICAL AND STREAM SEDIMENT RECONNAISSANCE

W. M. FAY AND P. L. JONES

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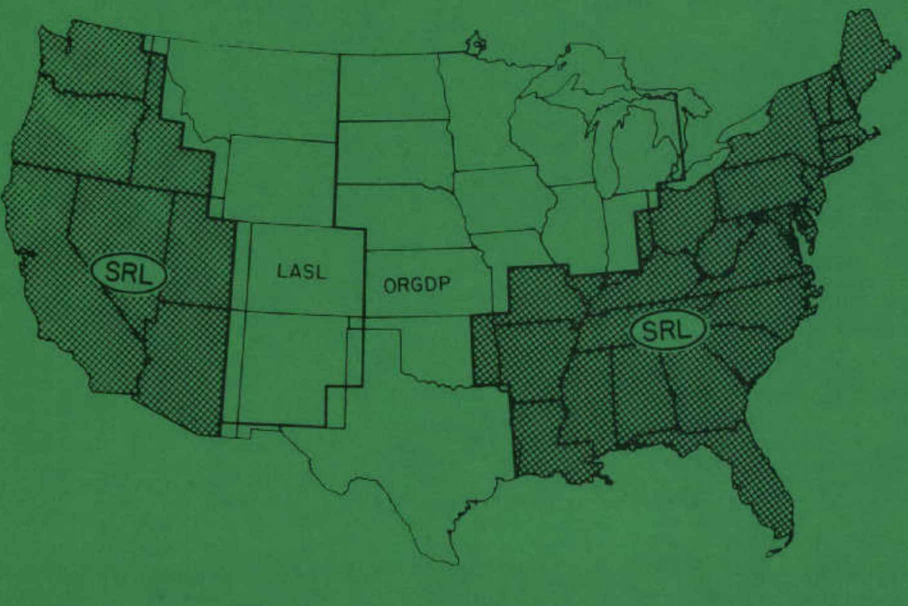
PREPARED FOR THE U. S. DEPARTMENT OF ENERGY UNDER CONTRACT DE-AC09-76SR00001

FOREWORD

This report is released without standard editorial and technical review in order to make the information available as soon as possible to interested organizations and to assist the search for uranium resources.

DISCLAIMER



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by

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ABSTRACT

This data report presents results of ground water and stream sediment reconnaissance in the National Topographic Map Series (NTMS) Walker Lake 1° x 2° quadrangle. Surface sediment samples were collected at 797 sites or at a nominal density of one site per 20 square kilometers (eight square miles). Ground water samples were collected at 77 sites or at a nominal density of one site per 220 square kilometers (87 square miles). Neutron activation analysis (NAA) results are given for uranium and 16 other elements in sediments, and for uranium and 8 other elements in ground water. Mass spectrometry results are given for helium in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Statistical summaries of data and a brief description of results are given. A generalized geologic map and a summary of the geology of the area are included.

Data from ground water sites (on microfiche in pocket) include (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements (water temperature, well description, and scintillometer reading), and (3) elemental analyses (U, Al, Br, d Cl, Dy, F, He, Mg, Mn, Na, and V).

Data from sediment sites (also on microfiche in pocket) include (1) water chemistry measurements (pH, conductivity, and alkalinity), and (2) elemental analyses (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation, etc.) are also tabulated. Symbol plot maps, histograms, and cumulative frequency plots for most elements, U/Th and U/Hf ratios, and scintillometer readings are included on the microfiche.

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WALKER LAKE TABLES

Tabulated reconnaissance data and elemental concentrations in surface and ground water samples.

WALKER LAKE S0 SED PLOTS 1

Symbol plot maps, histograms, and frequency distribution plots for U, Th, Hf, and Ce elements, U/Th and U/Hf elemental ratios, and scintillometer readings for the S0 coarse (>420 μm to <1000 μm) sediment samples.

WALKER LAKE S0 SED PLOTS 2

Similar to PLOTS 1; for Fe, Mn, Sc, Na, Ti, and V elements.

WALKER LAKE S1 SED PLOTS 1

Similar to above plots in format; data reported for U, Th, Hf, and Ce elements, U/Th and U/Hf elemental ratios, and scintillometer readings for the S1 fine (<149 μm) sediment samples.

WALKER LAKE S1 SED PLOTS 2

Similar to above plots in format for Fe, Mn, Sc, Na, Ti, and V elements.

USER'S GUIDE

DATA REPORT: WALKER LAKE 1° x 2° NTMS QUADRANGLE: CALIFORNIA AND NEVADA

INTRODUCTION

The National Uranium Resource Evaluation (NURE) program was established to evaluate domestic uranium resources in the continental United States and to identify areas favorable for uranium exploration. The Grand Junction Office (GJO) of the Department of Energy (DOE) is responsible for administering and coordinating NURE program efforts. The Savannah River Laboratory (SRL) has responsibility for hydrogeochemical and stream sediment reconnaissance (HSSR) of 3.9 million square kilometers (1,500,000 square miles) in 37 eastern and western states. Other DOE laboratories are responsible for similar reconnaissance in the rest of the continental United States including Alaska. The significance of the distribution of uranium in natural waters and stream sediments will be assessed as an indicator of areas favorable for the location of uranium deposits.

The principal objectives of the NURE program are:

- Increase geologic knowledge of U.S. uranium resources in regions where uranium ore bodies are known to exist and are candidate supplies under present and near-term market conditions.

- Complete assessment of lower cost potential uranium resources in the conterminous U.S. and Alaska.

- Improve reliability and validate resource estimates and increase confidence levels.

- Expand scope of uranium assessment to include higher cost and relatively unknown domestic resources that may be feasible uranium supply alternatives.

- Apply advanced technologies for detection and assessment of uranium resources.

DOE-GJO is responsible for administering and coordinating efforts to meet these objectives including distribution of reports.

Inputs to the NURE program come from DOE prime contractors, DOE-sponsored research and development, the uranium industry, U.S. Geological Survey, U.S. Bureau of Mines, other federal and state government agencies, and independent sources.

The NURE program consists of six parts:

1. Hydrogeochemical and Stream Sediment Reconnaissance Survey
2. Aerial Radiometric Survey
3. Intermediate Grade Resource Studies
4. World Class Geologic Studies
5. Subsurface Geologic Investigation
6. Technology Application

The data presented here are reconnaissance data intended for use in identifying broad areas for further study. While care has been taken to provide reliable sampling and analyses, verification of individual analyses is beyond the scope of this report. The data should be viewed statistically because "one-point anomalies" may be misleading. Regional trends, however, should be reliable. With careful consideration of regional geology, these data should provide reliable guides to areas warranting further study.

This report is one of a series presenting basic data obtained by SRL reconnaissance. In the interest of disseminating available data as soon as possible, only neutron activation analyses are reported here. Supplementary reports will be issued later. All data will be available on magnetic tape from:

GJOIS Project
UCC-ND Computer Applications Department
4500 North Building
Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, Tenn. 37830

A brief description of sampling and analytical procedures and a detailed description of the maps, tables, and figures contained in this report are presented in the SRL document **User's Guide to SRL Data Reports** (on microfiche in pocket). A summary of the SRL development program in support of the reconnaissance is available in SRL-NURE progress reports (SRL-138). SRL data reports (SRL-146) have been open-filed for other quadrangles (Figure 1).

Figure 2 summarizes the quadrangle abbreviations used in SRL sample identification numbers. Data collected in the field are recorded on a standard field data form (Figure 3).

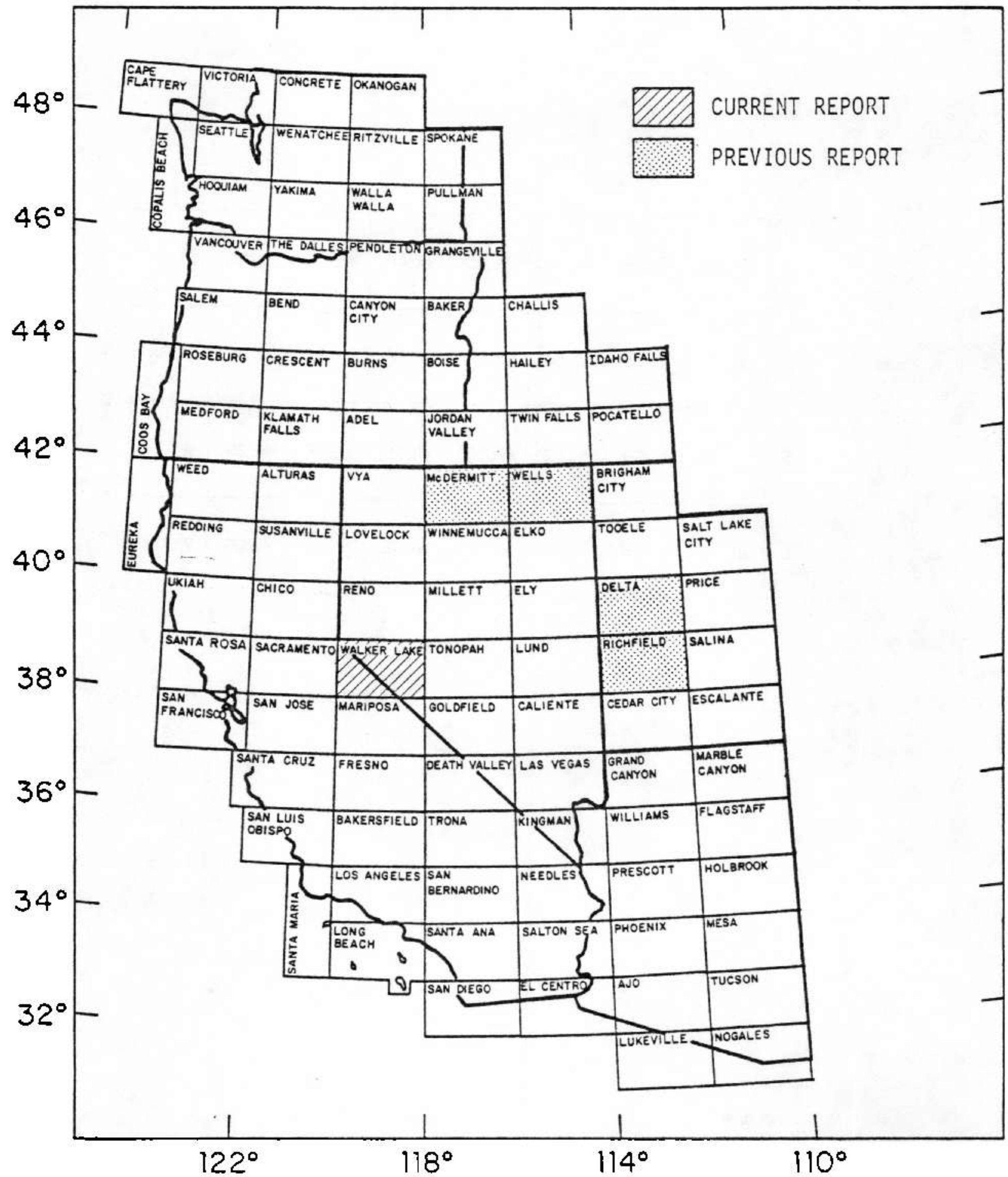

FIGURE 1. Location Map for the Walker Lake 1° x 2° NTMS Quadrangle

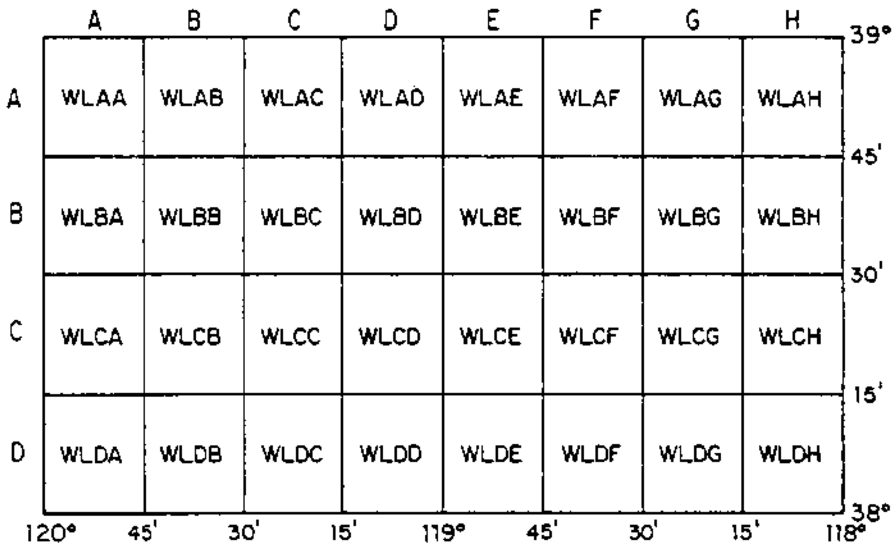

FIGURE 2. Codes for the 15' Quadrangles Imposed on the Walker Lake 1° x 2° NTMS Quadrangle

OSR-24-A-202

SRL FIELD DATA FORM

SITE CODE (Sheet 1–2, Map Code 3–4, Site Number 5–8) | DATE (Mo. 9–10, Day 11–12, Yr. 13–14, Hr. 15–16) | TEAM NO. 17–19 | Sample Type ⑳ | SURFACE SITE DATA: Rock Type ㉑, Sed Size ㉒, Width ㉓, Depth ㉔, Flow ㉕, Level ㉖, Veg Type ㉗, Veg Density ㉘, Relief ㉙, No. of Sample Composites 30–31, Activities Contaminants (List up to four) ㉜ ㉝ ㉞ ㉟ | 36–37 | Formation 38–39 | Odor ㊵

HAVE A GOOD DAY

pH 41–43 | SPECIFIC CONDUCTANCE μmhos/cm 44–48 | WATER TEMP, °C 49–50 | ALKALINITY (Drops H_2SO_4 51–52, ml Water 53–54) | ml OF WATER ION-EXCHANGED 55–58 | WELL DATA: WELL DEPTH 59–61, Condepth (62), Well Class. (63), Where Sample Taken (64) | STATE 65–66 | SCINTILLOMETER READING 67–70 | 71–76 | Inform. Request (77) | DO NOT USE 78–79 | CARD CODE (80)

Sheet 1–2 | Map Code 3–4 | Site Number 5–8 | ADDRESS (use / to separate lines) 9–40

41–80 (card code: 1 3)

IN THE CASE OF EACH CIRCLED ENTRY SPACE, ENTER MOST APPROPRIATE DESIGNATORS LISTED BELOW

⑳
A Other sediment (8)
B Other resin (9)
C Well water (9)
D Spring water (9)
E Stream sediment + water (8)
F Stream sediment only (8)
G Soil (8)
H Talus (8)

㉑
1 Other (explain)
2 Volcanic - Felsic
3 Volcanic - Mafic
4 Plutonic - Felsic
5 Metamorphic
6 Clastics - coarse
7 Sandstone
8 Shale
9 Carbonate

㉒
1 Other (explain)
2 Pebbles & coarser
3 Sand
4 Silt & clay
5 Organic muck

㉓ and ㉔
1 Dry
2 < ½'
3 ½ - 1'
4 1 - 2'
5 2 - 4'
6 4 - 8'
7 8 - 16'

㉕
1 Dry
2 Slow
3 Moderate
4 Fast
5 Torrent

㉖
1 Dry
2 Low
3 Normal
4 High

㉗
1 Other
2 Forest
3 Desert scrub
4 Grassland
5 Saltbush
6 Marsh

㉘
1 Sparse
2 Moderate
3 Dense

㉙
1 0 - 10'
2 10 - 50'
3 50 - 200'
4 >200'

㉜ thru ㉟
1 Other
2 None
3 Chemical
4 Smelting
5 Mining
6 Garbage
7 Farming
8 Grazing
9 Oil Field

㊵
1 Other
2 None
3 H_2S
4 Oil

(62)
1 Certain
2 Probable
3 Possible
4 Educated guess
5 Unknown

(63)
1 Other
2 Domestic
3 Municipal
4 Livestock
5 Irrigation
6 Industrial - commercial

(64)
1 Others
2 Immediately after storage tank
3 Before storage tank
4 Direct from pump
5 Direct from well or spring
6 From municipal system

(77)
Enter "X" when analysis information is requested

(80)
Enter number in parentheses ( ) for column 20 options

Sampler(s) Signature(s) ________ Field Supervisor (initials) ________

Standard Letters and Numbers A B C D E F G H I J K L M N Ø P Q R S T U V W X Y Ƶ 0 1 2 3 4 5 6 7 8 9

FIGURE 3. SRL Field Data Form

GEOLOGIC SUMMARY AND URANIUM OCCURRENCES

Geology

Introduction

The geology of the Walker Lake quadrangle is made up of two provinces, the Sierra Nevada and the Basin and Range (Figure 4). The Sierra Nevada Province is located in the western portion of the quadrangle and consists of a spectacular east-facing escarpment of individual peaks ranging to more than 3600 m (12,000 ft) in elevation in a slightly west-or-north trending zone. The central and eastern portions of the quadrangle are made up of basin and range structures characteristic of the Basin and Range Province.

Basin and Range Province

Rocks of the Basin and Range Province in the Walker Lake quadrangle range in age from Paleozoic to recent. Paleozoic rocks are found in this province only in the southeastern corner of the quadrangle. Mesozoic rocks are found throughout the province but comprise only a small percentage of the surface exposures. These rocks consist of metasediments, metavolcanics, and intrusive rocks. Rocks of Triassic to Jurassic age are of shallow marine origin and were deposited on the western margin of the previously eroded Antler orogenic belt (Silbering and Roberts, 1962). A Mesozoic orogeny began in Early Jurassic time and continued through Cretaceous (Willden, 1956). This orogenic sequence culminated in a series of Cretaceous granitic intrusives of widespread extent. Folding, faulting, and low-grade regional metamorphism with local high-grade thermal metamorphism of the pre-Cretaceous rocks characterize the orogenic sequence.

Tertiary and Quaternary rocks are widespread in the Walker Lake quadrangle and consist predominantly of Tertiary volcanic and associated sedimentary rocks and Quaternary lake deposits and volcanics. Table 1 summarizes the igneous sequence from Tertiary to recent in the Basin and Range Province. Cenozic deformation began in the Miocene and continues at present (Bonham, 1969). This deformation sequence is represented by normal faulting, tilting, folding, and volcanism. Walker Lane, a major wrench fault, is Cenozoic in age and extends northwest through the Walker Lake quadrangle along the line of the Gabbs Valley Range (Ross, 1961).

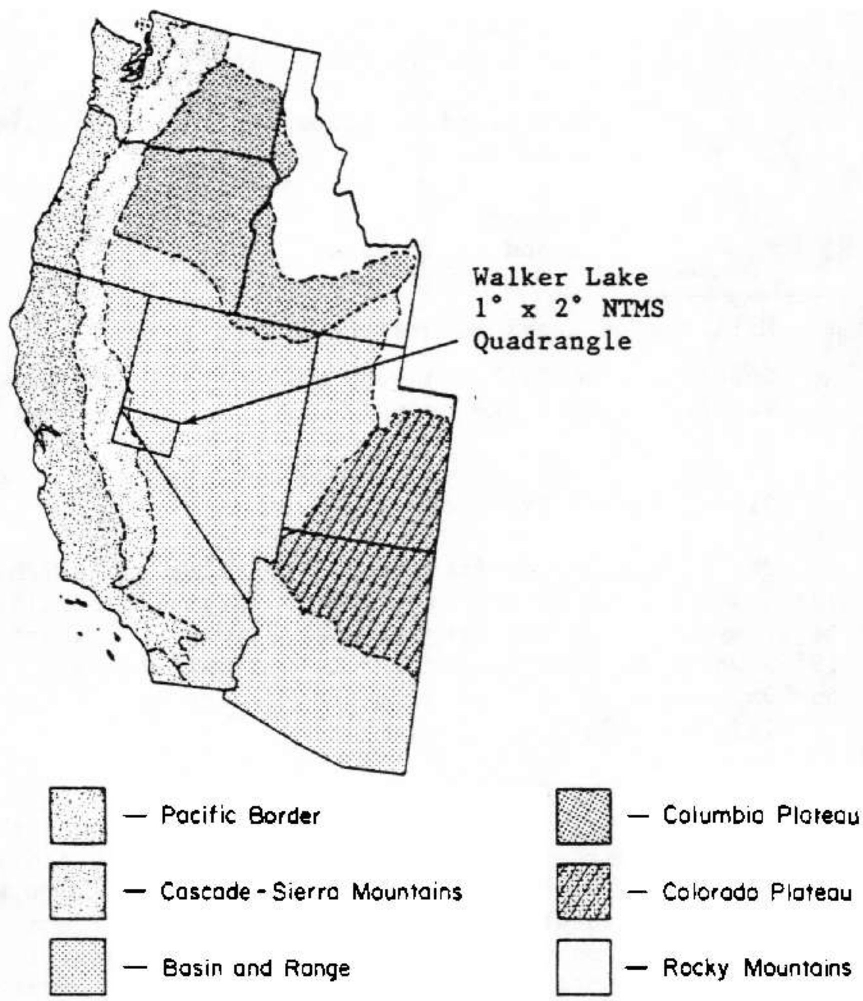

FIGURE 4. Location of the Walker Lake Quadrangle on a Physiographic Province Map

TABLE 1

Summary of Tertiary Igneous Events in the Walker Lake Quadrangle

Age, Myr BP[a]	Activity[b]
5	Eruption of alkaline andesites and dacites.
16	Basalt and rhyolite flows.
34	Widespread ash-flow sheets of rhyrolitic eruptions.
40	Emplacement of small igneous bodies and eruption of andesitic lavas.

a. Millions of years before the present.

b. Sequence from Silberman and McKee, 1973 (see also Appendix D for radiometric age dates).

Sierra Nevada Province

The Sierra Nevada Province is mostly a batholith of Cretaceous age. The axis of the Sierra Nevada batholith parallels that of a major syncline in the pre-Cretaceous rocks (Rinehart and others, 1959) which Bateman and others (1963) defined as a faulted synclinorium. Lake Tahoe lies east of the midpoint of the synclinorium (Taliaferro, 1942).

Invaded rocks range in age from middle Paleozoic to the present in the Walker Lake quadrangle. Pre-Cretaceous rocks constitute a small percentage of the outcrop of the batholith and are found mostly along the eastern portion of the Siera Nevada Province in the quadrangle. These pre-Cretaceous remnants are thermally metamorphosed to siliceous hornfels, commonly associated with small amounts of metamorphosed limestone. Precambrian rocks outcrop in the Sierra Nevada batholith a few miles south of the Walker Lake quadrangle (Bateman and others, 1963).

Mafic intrusives of Mesozoic age appear to be "forerunners" of the granitic batholith (Mayo, 1941) and consist of small bodies of diorite, quartz diorite, and hornblende gabbro (Bateman and Wahrhaftig, 1966). The granitic rocks make up the bulk of the batholith and comprise a large number of individual plutons. These plutons range in size from less than one square mile to more than 500 square miles. The larger plutons are generally elongated parallel to the axial trace of the Sierra Nevada batholith. Calkins (1930) demonstrated a general age relationship in which the individual plutons become progressively older to the west. Bateman and Wahrhaftig (1966) defined three major epochs of plutonism that occurred in Late Triassic to Early Jurassic, Late Jurassic, and early Cretaceous times. These plutonic episodes formed from melts moving upward from deeper regions (Bateman and others, 1963). The granitic rocks are generally classed as porphyritic and nonporphyritic, with the porphyritic intrusives further classed according to whether phenocrysts of K-feldspar are present or not.

Tertiary volcanic and associated sedimentary rocks outcrop extensively along the eastern edge of the Sierra Nevada Province in the Walker Lake quadrangle. These consist principally of Pliocene volcanic rocks with limited exposures of Miocene volcanic rocks. Tertiary exposures (including gravels) outline older landscapes of the Sierra Nevada Province with most of the older drainage to the west that is similar to the present drainage.

Pleistocene-to-recent glacial episodes correlate generally to world-wide glacial episodes and, at the height of glaciation, the Sierra Nevada range attained an icecap 270 miles long and 20 to 30 miles wide (Bateman and Wahrhaftig, 1966). Extensive glacial deposits are found in the Sierra Nevada Province in the Walker Lake quadrangle. These deposits correlate generally to four major glaciations represented by the Tioga, Tahoe, Sherwin, and McGee glacial stages (Blackwelder, 1931). Intermediate glaciations have been identified (Birman, 1964), and glaciation may have been fairly continuous during the Pleistocene and recent times.

General Features

Ten important geologic features of the Walker Lake 1° x 2° NTMS quadrangle have been identified. These are

1. Carson Range
2. Wassuk Range
3. Smith Valley
4. Excelsior Mountains
5. Mono Basin
6. Walker Lane
7. Garfield Hills
8. Candelaria Hills
9. Gillis Range
10. Gabbs Valley Range

The geology of these ten individual features is summarized below.

1. Carson Range

The Carson Range is located in the extreme northwest corner of the Walker Lake quadrangle. The rocks of the range consist of regionally and thermally metamorphosed basement overlain by Tertiary and Cenozoic volcanic and sedimentary deposits. The succession began with Mesozoic sediments metamorphosed by Cretaceous age granitic intrusives and regional dynamic metamorphism. Nonigneous rocks consist of hornfels, schist, slate, argillite, metagraywacke, quartzite, limestone, and marble. The Mesozoic rocks were succeeded by a period of Tertiary to Quaternary volcanism and associated sedimentation. The earliest volcanic sequence is represented by the Hartford Hill Rhyolite tuff (Gianella, 1936), followed by flows and tuffs of the Alta Formation (Calkins, 1944), and later by the Kate Peak Formation of Miocene or Pliocene age (Thompson and White, 1964). Associated sedimentary rocks vary in local areas (Axelrod, 1956).

2. Wassuk Range

The Wassuk Range consists of a large composite batholith of granitic composition and contains common roof pendants of the Excelsior Formation (Ross, 1961). Pliocene volcanic rocks are common in the northern part of the range and in the south along the western side of the range. The north-south trending Wassuk Range is a major divide in the Walker Lake quadrangle.

3. Smith Valley

Smith Valley was formed by faulting during the Quaternary. Active faulting continues to the present in the Walker Lake quadrangle (Callaghan and Gianella, 1935). The valley fill has a thickness of more than 500 feet and consists of fine-grained sediments with some sand (Loeltz and Eakin, 1953). Pleistocene Lake Lahontan may have covered Smith Valley for a time but, for most of Quaternary time, there was no drainage from Smith Valley. The valley is currently drained by the West Walker River. The Pleistocene lake level ranged up to 1500 m (4900 ft) elevation, and a few wave-cut benches still exist (Loeltz and Eakin, 1953).

4. Excelsior Mountains

The rocks of the Excelsior Mountains consist chiefly of granitic rocks and Tertiary volcanics. The Dunlap and Excelsior Formations are common in the eastern part of the range. The Dunlap Formation unconformably overlies the Excelsior but may represent only limited erosion of the Excelsior Formation (Ferguson and

Muller, 1949). Faulting within the range is principally of Tertiary and Quaternary age (Ross, 1961). Active faulting is indicated for the range. A recent (1935) earthquake to the east of the quadrangle developed a 1400 m (4500 ft) long scarp with a maximum height of 5 inches (Callaghan and Gianella, 1935).

5. Mono Basin

The Mono Basin is a structural depression partly filled with debris from its margins. The basin developed through regional warping and faulting during the last 3 to 4 million years (Christensen and others, 1969). Christensen and others (1969) believe the sedimentary depth of the basin to be 1 to 1.5 km. The basin lies in the "rain shadow" close to the Sierra Nevada Province and has a slowly lowering lake-level through man-made intervention with the drainage system. The basin is part of a regional pattern of faults related to the Death Valley area (Gilbert and others, 1968).

6. Walker Lane

The Walker Lane is a zone of right-lateral strike-slip faulting with associated dip-slip movement of possibly major proportions (Nielsen, 1965). The Walker Lane crosses the Walker Lake quadrangle along a northwest-southeast trend through the Gabbs Valley Range in the northeast corner of the quadrangle.

7. Garfield Hills

The Garfield Hills are generally low desert hills and have an easterly trend. The range is made up of a Mesozoic sequence which represents all the Mesozoic formations in the quadrangle. Granitic rocks intrude these formations which are, in turn, covered by Tertiary and Quaternary volcanic rocks. The Triassic formations are in an angular unconformable contact with each other, indicating uplift and folding during that time (Ross, 1961). The Jurassic Dunlap Formation records the beginning of the Jurassic to Cretaceous orogeny by the coarsening of the sediment upward in the unit.

8. Candelaria Hills

The Candelaria Hills are notable for containing Cambrian, Ordovician, and Permian formations and few intrusive rocks of Cretaceous age. The earliest orogeny in the quadrangle is evidenced in an angular unconformity between the folded Ordovician rocks and the overlying Permian Diablo Formation (Ross, 1961). The Candelaria Hills are a horst block of Quaternary age (Ross, 1961).

9. Gillis Range

The Gillis Range varies from a westerly trend in the south to a northerly trend in the north. The range consists of Mesozoic sedimentary and volcanic units, Cretaceous intrusives, and Tertiary units. Structures of the range include the Mesozoic Gillis thrust (which is sparsely and discontinuously exposed) and high-angle faulting of Tertiary age (Ross, 1961).

10. Gabbs Valley Range

The Gabbs Valley Range lies within the Walker Lane zone. Cenozoic faulting is common with faults trending mostly northwest (Ross, 1961). The rocks of the range are varied and consist of the Luning formation in the south and with Gabbs and Dunlap Formations present locally. Cretaceous granitic rocks are present, and most of the range is covered by Tertiary volcanic rocks.

Published Geologic Work

Previous work in the Walker Lake quadrangle includes that by Whitney (1865), Hill (1915), Muller and Ferguson (1939), Couch and Carpenter (1943), Ross (1961), and Carlson and others (1978). The open-file map by Carlson and others (1978) gives good detail at a 1:250,000 scale. Other mapping by Ferguson and others (1953, 1954), Ferguson and Muller (1949), Koenig (1963), and Albers and Stewart (1965) will be helpful for detailed work. Mineral resource publications include those by Bailey and Phoenix (1944), Geehan and Trengrove (1950), Kerr (1936), Knopf (1922), Matson and Trengove (1957), Moore (1969), Page (1959), and Thurston (1946). Stratigraphic nomenclature is compared in publications by Muller and Ferguson (1936, 1939), Rinehart and others (1959), and Van Houten (1956).

Uranium Occurrences

A great variety of mineral deposits have been prospected and/or mined in the Walker Lake quadrangle (see Plate 1B). Among these, silver has produced the highest value over the years of recorded mining history. Uranium has been prospected for widely and such activity continues at present (see Table 2 for some

TABLE 2

Reported Uranium Occurrences in the Walker Lake Quadrangle

Site	Location	Activity Factor*	Occurrence
1	Sec. 20 T13N.,R.19E.	20X	Pegmatite in granitic rocks.
2	Sec. 20 T.13N.,R19E.	4X	Pegmatite in granitic rocks
3	Sec. 33 T.13N.,R19E.	2X	Allanite in pegmatite in granite.
4	Sec. 12 (?) T.10N.,R.22E.	350X	Radioactive altered, metamorphosed conglomerate.
5	Sec. 31 (?) T.11N.,R23E.	4X	Radioactive fracture in granitic rocks.
6	Sec. 9, 16 (?) T.9N.,R23E.	17X	Radioactive iron-stained faults in Tertiary lake beds.
7	Sec. 16,17,20,21 T.13N.,R.25E.	4X	Uranium associated with azurite in copper mine.
8	Sec. 13 T.13N.,R.24E.	17X	Radioactive zone near base of Hartford Hill Rhyolite.
9	Sec. 25 T.13N.,R.23E.	--	Radium in 540 feet deep well.
10	Sec. 16 T.11N.,R26E.	10X	Autunite/torbernite in fractures in granite.
11	Sec. 3,4,9,10 T.10N.,R.25E.	40X	Radioactivity associated with fossil bones in Tertiary sandstone.
12	Sec. 16(?) T.10N.,R.26E.	14X	Carnotite in diatomaceous beds.
13	Sec. 31(?) T.10N.,R.27E.	--	Radioactive gold veins in granite.
14	Sec. 9 T.8N.,R.25E.	2X	Radioactive fractures in tuff.

* Field scintillometer gamma reading (counts/sec); factor equals specific site activity ÷ general background activity.

TABLE 2 (Contd)

Site	Location	Activity Factor*	Occurrence
15	Sec. 22(?) T.7N.,R.27E.	30X	Zeunerite in altered volcanic rock
16	Sec. 5(?) T.8N.,R.27E.	8X	Uraninite, uranophane in quartz vein in quartz monzonite.
17	Sec. 29 T.8N.,R.27E.	--	Radioactivity in sulfides in quartz vein.
18	Sec. 32,33 T.8N.,R.27E.	4X	Radioactivity in sulfides in veins from old mines.
19	Sec. (?) T.8N.,R.27E.	17X	Uranium minerals in sulfides in quartz veins.
20	Sec. 3(?) T.7N.,R.27E.	10X	Uranium minerals in fault in granite.
21	Sec. 5,6 T.7N.,R.27E.	--	Uranium in quartz veins in quartz monzonite.
22	Sec. 4(?) T.7N.,R.27E.	75X	Uranophane (?) in shear zone in granodiorite.
23	Sec. 36 T.8N.,R.27E.	--	Autunite/torbernite in shear zone in quartz monzonite.
24	Sec. 8 T.7N.,R.27E.	--	Radioactive hot spring.
25	Sec. 18 T.7N.,R.27E.	--	Radioactive fault in granodiorite.
26	Sec. 12 T.7N.,R.27E.	20X	Radioactivity in tuffs overlying quartz monzonite.
27	Sec. 16 T.9N.,R.31E.	12X	Radioactivity with copper in veins in granite.
28	Sec. 15 T.9N.,R.32E.	50X	Radioactivity in roof pendant in granite with iron deposits.
29	Sec. 18 T.9N.,R.33E.	18X	Radioactive iron-rich zone in Luning Fm. near granite.

* Field scintillometer gamma reading (counts/sec); factor equals specific site activity ÷ general background activity.

TABLE 2 (Contd)

Site	Location	Activity Factor*	Occurrence
30	Sec. 16 T.9N.,R.33E.	2X	Autunite in fault in andesite.
31	Sec (?) T.9N.,R.33E.	3X	Radioactive veins of calcite, opal, and silica in dolomite and andesite.
32	Sec. 13(?) T.10N.,R.33E.	2X	Radioactive zone in pyritic rhyolite.
33	Sec. (?) T.9N.,R.33E.(?)	38X	Uranium minerals in iron-stained granitic contact zone in sandstone.
34	Sec. 36(?) T.9N.,R.34E.	4X	Radioactive iron-stained fractures in Tertiary volcanics.
35	Sec. 21(?) T.7N.,R.33E.	6X	Radioactive iron and copper ores in Excelsior Fm.
36	Sec. 34(?) T.8N.,R.34E.	--	Unknown.
37	Sec. 35(?) T.7N.,R.34E.	--	Radioactivity in veins and breccia.
38	Sec. 10 T.8N.,R.33E.	250X	Uranium minerals in albitite dike in fault in quartz monzonite.
39	Sec. 2(?) T.8N.,R.33E.	67X	Uranium minerals in fault zone.
40	Sec. 3 T.8N.,R.33E.	--	Radioactive zone in altered granitic rocks.
41	Sec. 9 T.9N.,R.33E.	--	Thorite in scapolite.
42	Sec. 30(?) T.6N.,R.30E.	78X	Radioactive sulfide vein in granite.
43	Sec. 7,8(?) T.5N.,R.30E.	5X	Radioactive fractures with copper oxides in granite.
44	Sec. (?) T.5N.,R.32E.	35X	Torbernite in fractures in granite.

* Field scintillometer gamma reading (counts/sec); factor equals specific site activity ÷ general background activity.

TABLE 2 (Contd)

Site	Location	Activity Factor*	Occurrence
45	Sec. 27(?) T.5N.,R.32E.	5X	Autunite in shear in granite.
46	Sec. 31 T.5N.,R32E.	--	Uranium minerals in veins in granite.
47	Sec. 32(?) T.5N.,R.32E.	30X	Uranium minerals in fractures in andesite over granite.
48	Sec. (?) T.4N.,R.32E.	--	Uranium minerals in shear zone in granite.
49	Sec. 11(?) T.4N.,R.32E.	25X	Uranium minerals in sulfide-rich quartz veins in granite.
50	Sec. 15 T.4N.,R.32E.	23X	Radioactive quartz veins in granite.
51	Sec. 15,16,21 T.4N.,R.32E.	140X	Uranophane in quartz veins in granodiorite.
52	Sec. 15(?) T.4N.,R.32E.	40X	Uranium minerals in altered shear zones in granite.
53	Sec. 21 T.4N.,R.32E.	10X	Radioactive quartz veins in quartz monzonite.
54	Sec. 27(?) T.13N.,R.33E.	15X	Radioactive contact of limestone with granite.
55	Sec. 31 T.8N.,R.32E.	150X	Carnotite in sediments over granite, intruded by rhyolite.
56	Sec. 6(?) T.7N.,R.28E.	2X	Radioactive diatomite overlying rhyolite.
57	Sec. 32 T.7N.,R.29E.	33X	Radioactive iron-stained quartz vein in granite.
58	Sec. 2(?) T.6N.,R.29E.	113X	Autunite in fault between volcanics and granite.
59	Sec. (?) T.6N.,R.29E.	3X	Radioactive silicified zones in rhyolite.

* Field scintillometer gamma reading (counts/sec); factor equals specific site activity ÷ general background activity.

TABLE 2 (Cont.d)

Site	Location	Activity Factor*	Occurrence
60	Sec. 26 T.5N.,R.27E.	4X	Generally radioactive rhyolite.
61	Sec. 33 T.4N.,R.35E.	6X	Radioactive iron-stained zone in mine.
62	Sec. 8 T.12N.,R.34E.	25X	Autunite in fracture in rhyoliteic tuff
63	Sec. (?) T.4N.,R.22E.	--	Secondary uranium mineralization in fractures
64	Sec (?) T.4N.,R.22E.	--	Secondary uranium mineralization in fractures.
65	Sec (?) T4N.,R.19E.	--	Uranium minerals in fault.

* Field scintillometer gamma reading (counts/sec); factor equals specific site activity ÷ general background activity.

representative anomalies). Private interests are extensive and include land ownership, leasing, exploration, and preliminary ore studies. The Department of Energy is currently cooperating with The California Department of Mines and Geology in prospecting for uranium in The Dardanelles in Stanislaus National Forest of the Sierra Nevada Province near the western border of the Walker Lake quadrangle.

Tertiary basin studies indicate a low possibility for "roll-front" type uranium deposits in these basins. The basins may have potential where sufficient sedimentation has developed to allow for significant down-dip water travel. However, most basins in the Walker Lake quadrangle are relatively shallow and have held saline lakes having high evaporation rates compared to fresh water influx. However, because all basins of the quadrangle are end-points for drainage systems, any uranium carried to the basin must remain in the vicinity or flow away through ground water action. Of interest in the vicinity of the basins may be porous wall-rock where ground water travel would have been highest. Suggested reading is Garside (1973).

HYDROLOGY

Climate

The mountain section of the study area has cold winters and rather mild short summers. Some of the eastern portion has temperatures a few degrees warmer. The average July temperature is about 23°C, and the average January temperature is about 0 C (NOAA, 1978). The annual rainfall varies with elevation, ranging from 100 mm in the east to about 900 mm in the mountains in the west. Most of the precipitation comes during the winter months with a large percentage occurring as snowfall. Table 3 presents the precipitation totals for selected weather stations during 1978.

Geography

The southwestern one-third part of the study area lies in California and represents chiefly a section of the Sierra Nevada Province. The northeastern two-thirds part is in Nevada and is characterized by the Basin and Range Province.

In the Sierra Nevada Mountains, altitudes of some peaks are more than 3000 m. The mountains represent a block of resistant rocks, chiefly granitic. The block was uplifted during Tertiary time above the level of the Basin and Range Province. The Sierra Nevada Mountains are asymetrical, the western slopes in aggregate

TABLE 3

Precipitation Totals for 1978 at Selected Weather Stations

Weather Station and Elevation	Average Monthly Precipitation, mm											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Hetch Hetchy* (1180 m)	148.6	121.4	124.2	89.4	47.5	21.8	3.05	6.60	11.9	44.7	119.1	159.3
Woodfords (1730 m)	99.6	61.0	51.1	31.8	23.6	13.0	12.4	11.4	14.5	32.5	74.2	100.6
Mina (1390 m)	8.64	7.62	7.62	10.7	14.2	9.14	10.4	9.65	6.35	8.64	7.62	8.38
Minden (1440 m)	37.3	22.4	20.1	11.9	16.5	10.4	8.13	7.11	5.33	12.2	25.7	39.1

* Located in adjacent Mariposa quadrangle.

being more gentle. The crest of the Sierra Nevada Mountains is near its eastern margin and in some places is less than 25 km from the nearest valleys of the Basin and Range Province. Thus, steep slopes and rugged remnants of fault escarpments characterize the region bordering the Basin and Range Province. The topography of the higher parts of the Sierra Nevada Province is controlled in detail by glacial sculpture (Fenneman, 1943, p. 409). Some of the hills are rounded and without soil, and surface streams are interrupted by such glacial features as falls and lakes. The relatively high precipitation results in forests and a variety of mountain plants.

The Basin and Range Province has a series of mountain ranges, trending northward, and several intervening valleys. Lying between Wassuk Range on the west and Gillis Range on the east is Walker Lake, which is a hydrologic sink; the lake level at 1200 m is the lowest surface feature in the study area. Large areas are occupied by pediments with gentle overall slopes but rugged topography in detail. Many ephemeral streams have cut gorges and arroyos in the mountain slopes. Vegetation is sparse in the Basin and Range Province.

The Walker and Carson Rivers have large diversions for irrigation of farm lands. General farming is practiced throughout the area with some seasonal grazing in the eastern section.

The area has a population of about 20,000 (U.S. Bureau of Census, 1970). The area around Lake Tahoe occounts for most of the population.

Drainage and Hydrology

The crest of the Sierra Nevada mountain range is the major drainage divide in the study area. Southwestward drainage from the southwestern slopes of the Sierra Nevada Mountains is represented by a close network of streams and connecting small lakes from the high humid region into the Central Valley of California. Eastward and leeward of the Sierra Nevada Mountains, much of the drainage is ephemeral. The perennial stretches of most streams extend into waterless washes on the alluvium, as they lose water by evapotranspiration and by seepage into the ground. Walker River flows northward between the Sierra Nevada Mountains and the Wassuk Range above the 39th Parallel before looping eastward and southward into Walker Lake. The average discharge for 52 years for the Walker River near Wabuska, Nevada, is 4.390 m^3/s (155 ft^3/s). Both Walker Lake and Mono Lake are in topographically closed basins of the Basin and Range Province. Lake Tahoe and the smaller lakes of the Sierra Nevada Province belong to the more humid environment and to river segment areas and, therefore, these waters are moderately low in mineral matter.

Large ground water supplies have not been developed in the study area. In many places, adequate supplies of potable water are not available. The alluvial valleys contain some permeable sands and gravels, but Walker Lake Valley and other valleys east of Wassuk Range are typical of many desert basins that contain mineralized water. Antelope Valley and other alluvial valleys in the headwater parts of Walker River have more open drainage from perennial streams and, thus, have more potential for future development of ground water (Eakin and others, 1976).

The granites and other consolidated rocks of the Sierra Nevada Mountains contain fractures that are capable of producing 15 to 100 liters of water per minute in many soil-covered areas from wells as deep as 100 m. The Tertiary volcanics and other consolidated rocks of Wassuk Range and other mountains in the Basin and Range Province also have water-bearing fractures capable of yielding small quantities of ground water in some places. However, the scarcity of recharge and the low storage capacity of the soilless rocks restrict the yield of wells in such settings.

Although no water-table maps are available, it is easy to make inferences about the ground water system. Recharge comes chiefly from the more humid mountain slopes, where (1) water enters bedrock fractures and then discharges as springs or as underflow to the alluvium of the valleys or (2) water runs off overland in gullies and arroyos before reaching the alluvium. The water table lies more than 100 m below land surface beneath the ridge tops, but is within a few meters of the land surface in low parts of the valleys. In many of the valleys, a centripetal hydraulic gradient controls ground water flow toward the center of the valleys, where the water is dispersed by evapotranspiration.

Both the surface water and ground water of the Sierra Nevada Mountains are of good quality and are relatively low in total dissolved solids. Most of the surface water of the Walker River drainage basin west of Wassuk Range is of fair quality; although contributions from mineralized thermal springs and from concentrations of salts in water subjected to evapotranspiration tend to increase the total solids of the water downstream. Most of the ground water contains less than 1000 mg/L of dissolved solids, but ground water in the alluvium in the eastern half of the study area is greater. Fluoride and boron are undesirable mineral constituents in the ground water in Antelope Valley, and fluoride in excess of 1.5 mg/L also occurs in ground water in the Hawthorne area south of Walker Lake (McGuinness, 1963, p. 519). Water in Walker Lake and Mono Lake is salty, that in Mono Lake being saltier than sea water.

FACTORS AFFECTING THE DATA

Sediment and ground-water samples were collected during the spring and summer of 1979. The Yosemite National Park was not sampled. The lack of surface-water sites is due to the arid nature of most of this quadrangle. The sparsity of ground-water sites is due primarily to the lack of significant population in this quadrangle. Windblown contamination may be a significant factor in the fines (<149 μm) fraction of surface samples, particularly in the relatively flat dry areas.

QUALITY ASSURANCE

Sample Collection

Ninety sediment and ten ground-water sampling sites were field-checked by an SRL subcontractor during August 1979. About 95% of the sites checked were found to be located within 0.5 mile of the actual locations. Thus, the goals of a regional reconnaissance have not been compromised by mapping errors. Details of the quality assurance program are given elsewhere (SRL-138).

Analytical Standards

Sediment Standards SRL 2.2, 3.1, and 4.1 were analyzed along with NURE sediment samples to provide precision data and routine systems checks for the analytical equipment and software. Tables 4a, 4b, and 4c contain the results from the standards run during the same time period as the Walker Lake sediment samples. These results give a good estimate of the precision of the data and can be used in estimating bias between this and other SRL reports.

Periodically, DOE intersite comparison standards are analyzed. An independent quality assurance program based on these standards is conducted for DOE by Ames (Iowa) Laboratory (D'Silva, et al.).

RESULTS AND DISCUSSION OF THE DATA

Stream Sediment Samples

SRL experience with sediments derived from crystalline rocks shows that much of the uranium in the sediments is present in resistate minerals. Interpretation of uranium concentrations of those sediment samples must include consideration of the mineral host of uranium.

TABLE 4a

Accuracy and Precision of SRL 2.2 Analyses

Element	Number*	Mean, ppm	Standard Deviation, $\pm 1\sigma$	Coefficient of Variation, %	Nominal Value, ppm**
U	49	21.8	2.6	12.0	22.2
Th	47	101	19.4	19.2	125
Hf	48	130	27	21.0	173
Al	48	8221	1675	20.4	6500
Ce	47	473	84	17.9	614
Fe	47	5926	1394	23.5	6700
Mn	48	236	53	22.4	300
Sc	47	2.8	0.6	22.5	3.9
Na	47	123	45	36.9	145
Ti	46	11,000	2771	25.3	13,200
V	48	30.6	6.9	22.5	34.7
Dy	46	24.0	9.3	38.7	<22
Eu	32	2.1	0.6	26.1	2.5
La	45	311	109	34.9	301
Lu	47	2.1	0.5	22.5	2.9
Sm	33	38.6	17.6	45.6	51.3
Yb	40	17.0	15.9	93.3	18.2

* Number of determinations.

** See Reference SRL-138, No. 16 [GJBX-160(79)], pp. 20-22.

TABLE 4b

Accuracy and Precision of SRL 3.1 Analyses

Element	Number*	Mean, ppm	Standard Deviation, $\pm 1\sigma$	Coefficient of Variation, %	Nominal Value, ppm**
U	46	41.7	3.3	8.0	41.3
Th	43	138	17.1	12.4	162
Hf	34	5.0	1.2	23.5	7.4
Al	46	42,200	4,750	11.3	30,600
Ce	36	743	105	14.1	903
Fe	41	13,200	2623	19.9	15,200
Mn	45	233	59.5	25.5	289
Sc	45	3.4	1.0	29.7	4.19
Na	45	815	111	13.7	901
Ti	38	4794	1206	25.2	6100
V	46	42.5	7.7	18.1	54.4
Dy	43	52.0	17.9	34.4	50
Eu	37	3.6	0.7	19.4	3.86
La	43	441	105	23.8	443
Lu	37	3.8	0.5	13.2	4.4
Sm	32	67.8	29.3	43.2	69.2
Yb	39	29.8	18.8	63.2	29.9

* Number of determinations.

** See Reference SRL-138, No. 16 [GJBX-160(79)], pp. 20-22.

TABLE 4c

Accuracy and Precision of SRL 4.1 Analyses

Element	Number*	Mean, ppm	Standard Deviation, $\pm 1\sigma$	Coefficient of Variation, %	Nominal Value, ppm**
U	43	0.6	0.1	19.5	0.58
Th	11	2.6	1.0	37.9	2.1
Hf	33	2.7	0.9	32.8	4.4
Al	43	78,300	6500	8.3	66,700
Ce	22	47.4	13.3	28.0	44
Fe	41	70,700	8874	12.6	87,300
Mn	43	1565	248	15.8	1970
Sc	42	13.9	4.1	29.1	21
Na	43	15,600	2,140	13.8	16,100
Ti	41	20,800	4,690	22.6	25,200
V	43	229	33.8	14.8	273
Dy	5	8.7	6.5	75.5	<22
Eu	21	1.4	0.9	60.9	1.16
La	12	16.3	10.0	61.8	18.6
Lu	10	0.4	0.2	45.2	0.28
Sm	14	6.3	6.4	100.9	4.2
Yb	3	5.1	5.4	106.8	1.6

* Number of determinations.

** See Reference SRL-138, No. 16 [GJBX-160(79)], pp. 20-22.

The total amount of uranium in a given stream sediment sample may be more a function of stream gradient or sampling conditions than of any proximity to a commercial uranium deposit. For example, if uranium were uniformly present in the mineral zircon at a concentration of 5000 ppm, then a uranium distribution map for stream sediment samples of less than 149 micrometers would have highs and lows which were functions of many factors. These include: (1) the areal distribution of zircon, (2) the areal distribution of zircon grain size, (3) the effectiveness of sampled streams in sorting and concentrating zircon relative to diluent minerals such as quartz or micas, and (4) the effectiveness of the sampling method in obtaining "representative" samples.

Comparing the distribution of uranium with the distribution of the U/Zr (or U/Hf) ratio should show where zircon is an important contributor to the amount of uranium. The ratio of U/Hf should be low where zircon is the primary mineral host of uranium in sediment samples. High values of the ratio indicate areas where uranium is present in minerals other than zircon or where zircon is particularly enriched in uranium.

Using the same logic, areas where values of the U/Th ratio are high show either that uranium is present in minerals other than resistates (such as monazite) or that these resistates are particularly enriched in uranium.

Many of the higher uranium values from the sediment samples from the Walker Lake NTMS 1° x 2° quadrangle are from sites underlain by Mesozoic intrusive rocks. The highest uranium concentration in sediments found in the quadrangle is 88.6 parts per million.

Analytical values above detection limits are summarized in Table 5. Table 5a contains the results for the fine (<149 μm) fraction. Table 5b contains the results for the coarse (>420 μm and <1000 μm) fraction.

Ground Water Samples

Concentrations of uranium in ground water samples are dependent on several factors: (1) the concentration of uranium in the rocks (soils) through which the water passes, (2) the rate at which the uranium-bearing minerals in the rocks (soils) will release uranium, (3) the hydrologic character of the rocks (soils), and (4) the chemistry of the water (especially Eh, pH, and alkalinity).

The interpretation of analyses of uranium in natural waters is not straightforward. In active roll-front deposits, solubility

TABLE 5

Statistical Summary of Elemental Analyses - Sediment, Walker Lake

a. Fine Fraction (S1); Sieved, <149 μm

Element	n*	Measured Values: Maximum**	Measured Values: Minimum†	$\left[\frac{\text{Log Mean††}\ (\Sigma \text{Log}_{10} x)}{n}\right]$	Log. Std. Deviation
U	793	88.6	0.9	0.68	0.18
Th	776	106	1	1.11	0.22
Hf	756	40	1	0.76	0.23
Al	784	115,800	14,600	4.88	0.08
Ce	684	226	10	1.72	0.16
Fe	760	124,300	4500	4.45	0.19
Mn	765	2620	90	2.76	0.17
Na	783	160,300	2700	4.24	0.16
Sc	786	19.0	0.2	0.74	0.20
Ti	626	32,000	300	3.52	0.25
V	783	396	6	1.84	0.25
Dy	187	23.1	0.8	0.51	0.30
Eu	429	5.8	0.3	0.01	0.22
La	87	137	13	1.39	0.12
Lu	241	1.2	0.1	-0.50	0.19
Sm	86	8	2	0.48	0.13
Yb	35	6.2	1.1	0.30	0.18

* Number of observations.

** Elemental concentrations in ppm.

† Minimum or detection limit.

†† Mean of values above detection limit.

TABLE 5 (Contd)

b. Coarse Fraction (SO); Sieved, >420 μm and <1000 μm

Element	n*	Measured Values Maximum**	Minimum†	Log Mean†† $\left[\frac{(\Sigma \mathrm{Log}_{10}\, x)}{n}\right]$	Log. Std. Deviation
U	793	53.9	1.0	0.48	0.16
Th	762	55	1	0.87	0.21
Hf	613	11	1	0.40	0.21
Al	790	107,000	22,700	4.86	0.08
Ce	637	142	5	1.60	0.21
Fe	773	180,400	2000	4.25	0.24
Mn	763	3430	30	2.64	0.26
Na	786	213,700	2700	4.24	0.19
Sc	790	18.1	0.2	0.57	0.27
Ti	601	19,400	300	3.33	0.30
V	778	469	3	1.64	0.33
Dy	130	20.6	0.8	0.45	0.30
Eu	402	4.3	0.2	0.01	0.22
La	83	68	7	1.31	0.19
Lu	131	1.6	0.1	-0.58	0.21
Sm	77	6	1	0.39	0.17
Yb	12	3.8	1.1	0.31	0.20

* Number of observations.

** Elemental concentrations in ppm.

† Minimum or detection limit.

†† Mean of values above detection limit.

of uranium may be low. Concentrations of uranium in natural waters may be very low near areas of active uranium deposition or very high in oxidizing zones near dissolving ore bodies.

Interpretation of the ground-water analyses from the Walker Lake 1° x 2° NTMS quadrangle is difficult because there are so few samples. However, these results may be useful for regional surveys. Table 6 contains the results of ground-water analyses that were above the detection limits.

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TABLE 6

Statistical Summary of Elemental Analyses - Ground Water

Variable	n*	Measured Values Maximum**	Minimum†	Mean††	Log Mean¶ $\left[\frac{(\Sigma \text{Log}_{10}\, x)}{n}\right]$	Log. Std.¶ Deviation	Standard Deviation ±1σ
pH	29	8.8	7.0	7.8			0.45
Conductivity	29	1600	56		2.42	0.32	
Alkalinity	29	5.0	0.4		0.34	0.27	
U	29	39.6	0.03		0.48	0.79	
Al	29	1025	94		2.32	0.24	
Br	18	3589	29.8		2.10	0.62	
Cl	29	237,100	5600		4.23	0.37	
Dy	2	0.36	0.22		-0.55	0.15	
F	25	1199	17		2.01	0.46	
He¶¶	26	81.0	4.7		0.87	0.26	
Mg	23	23,720	880		3.69	0.37	
Mn	20	277.9	49.7		1.97	0.22	
Na	29	168,050	13,820		4.48	0.26	
V	20	26.0	1.0		0.61	0.33	

* Number of observations. Some values are missing for reasons other than being below detection limit.

** Elemental concentrations in ppb; conductivity in µmhos/cm; alkalinity in meq/L.

† Minimum or detection limit.

†† Mean of values above detection limit.

¶ Log units.

¶¶ Helium in ppm by volume.

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No.	Period	SRL Doc. No.	DOE-GJO Doc. No.*
1	January-March 1975	DPST-75-138-1	GJBX-5(76)
2	April-June 1975	DPST-75-138-2	GJBX-6(76)
3	July-September 1975	DPST-75-138-3	GJBX-7(76)
4	October-December 1975	DPST-75-138-4	GJBX-8(76)
5	January-March 1976	DPST-76-138-1	GJBX-17(76)
6	April-June 1976	DPST-76-138-2	GJBX-27(76)
7	July-September 1976	DPST-76-138-3	GJBX-63(76)
8	October-December 1976	DPST-76-138-4	GJBX-6(77)
9	January-March 1977	DPST-77-138-1	GJBX-35(77)
10	April-June 1977	DPST-77-138-2	GJBX-55(77)
11	July-September 1977	DPST-77-138-3	GJBX-90(77)
12	October-December 1977	DPST-77-138-4	GJBX-37(78)
13	January-March 1978	DPST-78-138-1	GJBX-66(78)
14	April-September 1978	DPST-78-138-2	GJBX-13(79)
15	October 1978-March 1979	DPST-79-138-1	GJBX-86(79)
16	April-September 1979	DPST-79-138-2	GJBX-160(79)

SRL-146, **SRL-NURE Data Reports**, E. I. du Pont de Nemours & Co. Savannah River Laboratory, Aiken, S.C.

No.	NTMS 1° x 2° Quadrangle	SRL Doc. No.	DOE-GJO Doc. No.*
1	Winston-Salem†	DPST-77-146-1	GJBX-66(77)
2	Spartanburg	DPST-77-146-2	GJBX-09(78)
3	Charlotte	DPST-78-146-1	GJBX-40(78)

* DOE-GJO reports are available on microfiche from the Grand Junction Office, DOE, for $6.00. Prepaid orders should be sent to Bendix Field Engineering Corporation, Technical Library, P.O. Box 1569, Grand Junction, CO 81501. Checks or money orders should be made out to Bendix Field Engineering Corporation, the operations contractor for DOE's Grand Junction Office.

4	Greenville	DPST-78-146-2	GJBX-47(78)
5	Winston-Salem††	DPST-78-146-3	GJBX-58(78)
6	Greensboro	DPST-78-146-4	GJBX-74(78)
7	Knoxville	DPST-78-146-5	GJBX-75(79)
8	Scranton	DPST-78-146-6	GJBX-02(79)
9	Athens	DPST-78-146-7	GJBX-20(79)
10	Harrisburg	DPST-79-146-1	GJBX-31(79)
11	Portland	DPST-79-146-2	GJBX-28(79)
12	Glens Falls	DPST-79-146-3	GJBX-44(79)
13	Augusta	DPST-79-146-4	GJBX-45(79)
14	Dyersburg	DPST-79-146-5	GJBX-58(79)
15	Poplar Bluff	DPST-79-146-6	GJBX-63(79)
16	Hartford	DPST-79-146-7	GJBX-94(79)
17	Williamsport	DPST-79-146-8	GJBX-152(79)
18	Newark	DPST-79-146-9	(in process)
19	Albany	DPST-79-146-10	GJBX-140(79)
20	Atlanta	DPST-79-146-11	GJBX-129(79)
21	Delta, Richfield	DPST-79-146-12	GJBX-161(79)
22	Walker Lake	DPST-79-146-13	(this report)

† Sediment only. †† Ground water only.

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APPENDIX: Radiometric Ages of Rocks in the Walker Lake 1° x 2° NTMS Quadrangle

A large number of age dates are available from rocks in the Walker Lake quadrangle. A representative sampling is provided in Table I.

TABLE I

Radiometric Age by K-Ar Dating Method

Site	Location	Geologic Age and Error Limit, Myr, BP	Ref.	Rock Type (Mineral)
1	T6N,R34E	18.9(0.8)	1	Latite intrusive (Plagioclase)
2	T6N,R34E	22.0(0.7)	1	Rhyodacite tuff (Plagioclase)
3a	T6N,R34E	24.2(0.7)	1	Rhyolite tuff (Biotite)
3b	T6N,R34E	24.8(1.0)	1	Rhyolite tuff (Plagioclase)
4a	T5N,R34E	73.9(2.2)	1	Granite dike (Alkali feldspar)
4b	T5N,R34E	89.5(2.7)	1	Granite dike (biotite)
5a	T5N,R34E	78.5(2.4)	1	Granite (alkali feldspar)
5b	T5N,R34E	92.8(2.8)	1	Granite (biotite)
5c	T5N,R34E	70.3(2.1)	1	Granite (plagioclase)
6a	T5N,R34E	96.8(2.9)	1	Diorite (biotite)

TABLE I (continued)

Site	Location	Geologic Age and Error Limit, Myr, BP	Ref.	Rock Type (Mineral)
6b	T5N,R34E	91.5(4.6)	1	Diorite (hornblende concentrate)
7	T5N,R34E	101(4)	1	Diorite (biotite)
8	T6N,R34E	5.9(0.2)	2	Tuffaceous sediments (biotite)
9a	T6N,R34E	15.7(0.5)	3	Andesite (biotite)
9b	T6N,R34E	16.1(0.7)	3	Andesite (plagioclase)
10	T5N,R34E	21.9(1.4)	4	Crystal tuff (plagioclase)
11	T5N,R34E	27.2(1.5)	4	Crystal tuff (biotite)
12	T6N,R34E	15.4(0.5)	3	Hydrothermally altered rocks (K-feldspar)
13	T5N,R34E	17.3(0.2)	5	Hydrothermally altered rocks (K-feldspar)
14a	Yerington dist.	31.7(1.8)	6	Singatse tuff (hornblende)
14b	Yerington dist.	27.2(1.1)	6	Singatse tuff (biotite)
15a	Yerington dist.	28.0(1.0)	6	Tuff (biotite)
15b	Yerington dist.	25.1(1.8)	6	Tuff (plagioclase)
16a	Yerington dist.	27.8(1.0)	6	Tuff (biotite)

TABLE I (continued)

Site	Location	Geologic Age and Error Limit, Myr, BP	Ref.	Rock Type (Mineral)
16b	Yerington dist.	26.1(0.9)	6	Tuff (sanidine)
17	Yerington dist.	27.1(0.9)	6	Tuff (biotite)
18a	Yerington dist.	24.1(0.9)	6	Tuff and breccia (biotite)
18b	Yerington dist.	23.6(2.0)	6	Tuff and breccia (plagioclase)
19a	Yerington dist.	18.9(2.8)	6	Andesite (plagioclase)
19b	Yerington dist.	18.5(2.5)	6	Andesite (Hornblende)
20a	Yerington dist.	18.7(1.9)	6	Andesite (hornblende)
20b	Yerington dist.	17.0(2.5)	6	Andesite (plagioclase)
21a	Yerington dist.	18.7(2.5)	6	Andesite (hornblende)
21b	Yerington dist.	18.5(2.7)	6	Andesite (plagioclase)
22	Yerington dist.	17.7(2.4)	6	Andesite (hornblende)
23	McConnell Canyon	10.6(1.0)	6	Basalt flow (Whole rock)
24	McConnell Canyon	8.6(1.3)	6	Basalt flow (whole rock)
25	Yerington dist.	8.2(1.2)	6	Basalt flow (whole rock)
26	T10N,R18E	13.4(1.5)	7	Andesite (plagioclase)

TABLE I (continued)

Site	Location	Geologic Age and Error Limit, Myr, BP	Ref.	Rock Type (Mineral)
27	T9N,R22E	11.2(0.3)	7	Andesite (plagioclase)
28	T9N,R22E	15.0(0.5)	7	Andesite (hornblende)
29	T8N,R18E	7.3(0.3)	7	Andesite (hornblende)
30	T8N,R18E	12.1(0.5)	7	Andesite (hornblende)
31	T10N,R23E	14.8(0.4)	7	Andesite (hornblende)
32	38°42.92'N 119°47.33'W	10.5(0.3)	7	Andesite (hornblende)
33	T12N,R22E	11.0(0.3)	7	Dacite (hornblende)
34	T5N,R22E	8.9(0.3)	7	Latite (biotite)
35	T5N,R22E	9.1(0.3)	7	Latite (biotite)
36a	T10N,R21E	9.5(0.3)	7	Andesite (biotite)
36b	T10N,R21E	9.7(0.4)	7	Andesite (plagioclase)
37a	T4N,R21E	20.0(0.8)	7	Basalt (whole rock)
37b	T4N,R21E	19.2(0.8)	7	Basalt (whole rock)
38a	T11N,R32E	23.1(0.7)	7	Andesite (hornblende)
38b	T11N,R32E	22.0(0.7)	7	Andesite (plagioclase)

TABLE I (continued)

Site	Location	Geologic Age and Error Limit, Myr, BP	Ref.	Rock Type (Mineral)
39	T9N,R34E	15.4(0.5)	7	Andesite (plagioclase)
40a	T10N,R33E	22.1(0.7)	7	Rhyodacite tuff (plagioclase)
40b	T10N,R33E	23.1(o.7)	7	Rhyodacite tuff (biotite)
41	T12N,R30E	25.6(0.8)	7	Quartz latite tuff (sanidine)
42	T11N,R30E	26.7(0.8)	7	Quartz latite tuff (sanidine)
43a	T11N,R30E	28.3(0.9)	7	Quartz latite ash flow (sanidine)
43b	T11N,R30E	25.0(0.8)	7	Quartz latite ash flow (sanidine)
44	T9N,R33E	19.5(0.6)	7	Tuff (alunite)
45	T10N,R21E	4.95(0.24)	7	Altered Rhyolite (sericite)
46	T10N,R21E	4.76(0.19)	7	Altered rhyolite (whole rock)
47	T5N,R28E	10.9(0.3)	7	Altered andesite (whole rock)
48	T5N,R34E	17.3(0.2)	7	Silver Dyke vein (K-feldspar)
49	T5N,R34E	75.9(2.3)	7	Vein in diorite (K-feldspar)
50	T3N,R35E	126(4)	8	Quartz monzonite (muscovite)
51	T3N;R35E	22.8(0.7)	8	Rhyolite (sanidine)

TABLE I (continued)

Site	Location	Geologic Age and Error Limit, Myr, BP	Ref.	Rock Type (Mineral)
52	T4N,R35E	3.9(0.4)	8	Basalt (whole rock)
53	T8N,R31E	8.5(0.3)	8	Basalt (whole rock)
54a	T13N,R31E	14.6(0.4)	8	Rhyolite (whole rock)
54b	T13N,R31E	14.7(0.4)	8	Rhyolite (sanidine)
55	T13N,R32E	15.5(0.5)	8	Altered rhyolite (muscovite)
56a	T6N,R34E	15.3(0.5)	8	Andesite (biotite)
56b	T6N,R34E	15.7(0.7)	8	Andesite (plagioclase)
57	T6N,R34E	15.0(0.5)	8	Adularia (adularia)
58	T7N,R33E	142(3)	9	Dunlap formation Biotite
59	T4N,R35E	2.8(0.1)	10	Basalt (whole rock)
60	T4N,R35E	2.9(0.1)	10	Basalt (whole rock)
61	T6N,R34E	5.7(0.2)	10	Volcanogenic sediments (biotite)
62	T7N,R35E	7.3(0.2)	10	Volcanogenic sediments (hornblende)
63a	T5N,R34E	17.3(1.1)	10	Andesite (hornblende)
63b	T5N,R34E	17.4(0.6)	10	Andesite (plagioclase)

TABLE I (continued)

Site	Location	Geologic Age and Error Limit, Myr, BP	Ref.	Rock Type (Mineral)
64	T3N,R35E	15.7(0.5)	10	Andesite (whole rock)
65	T3N,R35E	22.2(0.8)	10	Crystal tuff (biotite)
66	T4N,R35E	22.9(0.5)	10	Crystal tuff (sanidine)
67	T4N,R34E	24.6(0.9)	10	Crystal tuff (biotite)
68	T6N,R34E	21.4(0.9)	10	Crystal tuff (plagioclase)
69	T4N,R35E	24.1(1.9)	10	Basalt (whole rock)
70	T3N,R35E	24.2(0.9)	10	Crystal tuff (biotite)
71	T3N,R35E	24.7(0.8)	10	Crystal tuff (biotite)
72	T5N,R34E	27.1(1.5)	10	Crystal tuff (biotite)
73	T6N,R35E	68.7(1.8)	10	Quartz monzonite (biotite)
74a	T13N,R32E	87.5(1.0)	11	Granodiorite (biotite)
74b	T13N,R32E	83.6(3.5)	11	Granodiorite (biotite)
75	East Smith Valley	9.3	11	Tuff (biotite)
76	T7N,R28E	11.2	11	Tuff (biotite)
77	Coal Valley	11.0	11	Tuff (biotite)

TABLE I (continued)

Site	Location	Geologic Age and Error Limit, Myr, BP	Ref.	Rock Type (Mineral)
78	Coal Valley	10.6	11	Tuff (glass)
79a	Coal Valley	10.5	11	Tuff (biotite)
79b	Coal Valley	11.2	11	Tuff (biotite)
80	Coal valley	10.8	11	Tuff (biotite)

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8. Op. cit., ref. 5.

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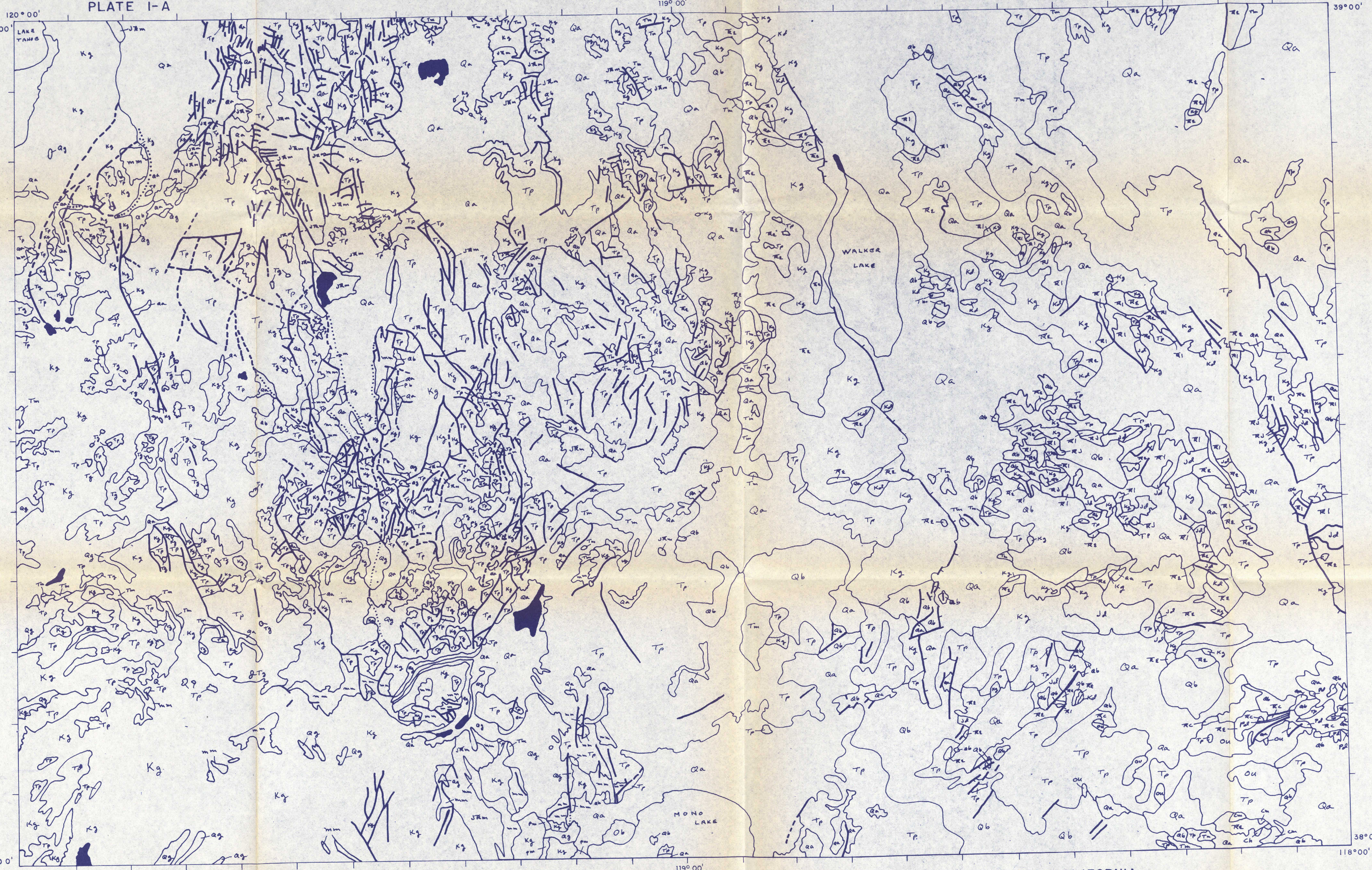
WALKER LAKE

PLATE I-A



WALKER LAKE, NEVADA; CALIFORNIA
GEOLOGIC MAP
PLATE I-A

RECENT — PLEISTOCENE	Qa	Alluvium
	Qg	Glacial deposits
	Qb	Mafic volcanics, mostly basalt
PLIOCENE	Tp	Undifferentiated volcanic and sedimentary rocks
	Tg	Granitic rocks
MIOCENE	Tm	Undifferentiated volcanic and sedimentary rocks
CRETACEOUS	Kg	Intrusive rocks mostly granitic
	Kd	Intrusive rocks mostly dioritic
JURASSIC	Jd	Dunlap formation, sandstone, volcanic, conglomerates.
	Jml	Undifferentiated marine rocks
	JTRm	Jurassic or Triassic metamorphic rocks
TRIASSIC	TRJ	Gabbs formation, limestone and shale
	TRl	Luning formation, siltstone and shale
	TRe	Excelsior formation, volcanic rocks
	TRc	Candelaria formation, shale and limestone
MESOZOIC	mb	Mesozoic basic intrusives,
	mm	Pre-Cretaceous metamorphic rocks
PALEOZOIC	Pm	Paleozoic metamorphic rocks
PERMIAN	Pd	Diablo formation, sandstone
ORDOVICIAN	ou	Ordovician rocks, undivided
CAMBRIAN	Єh	Harkless formation, siltstone
	Єm	Miller Mountain formation, meta-limestone and shale

SCALE 1:250,000

5 0 5 10 15 20 Statute miles

5 0 5 10 15 20 25 30 Kilometers

N

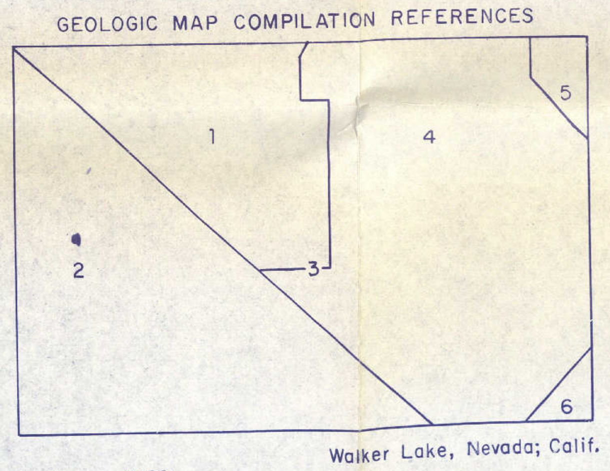
Geologic contact

Fault, line on downthrown block

Small body of water

Compiled by D. E. Howell 1979

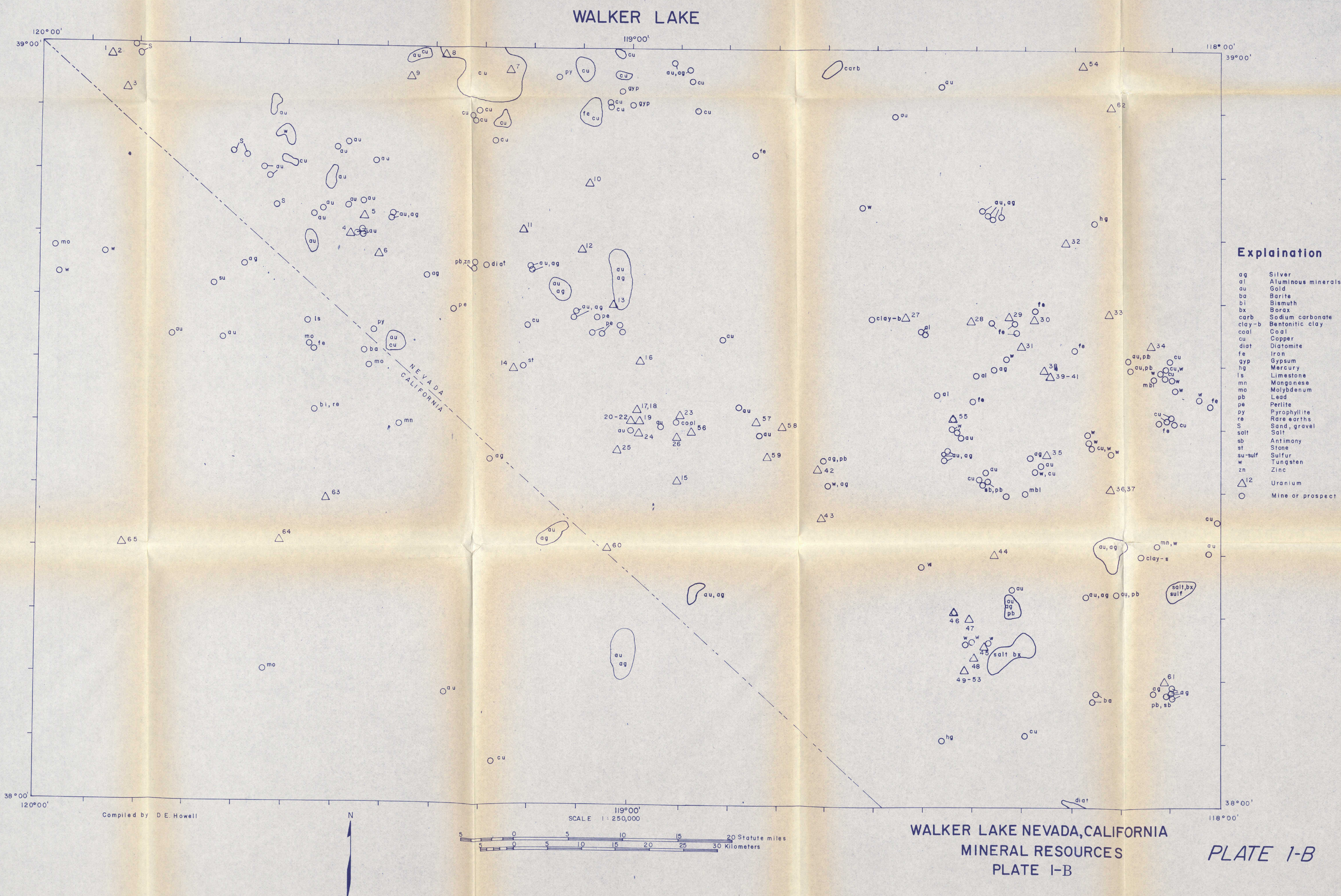
GEOLOGIC MAP COMPILATION REFERENCES



Walker Lake, Nevada; Calif.

1. Moore, 1969
2. Koenig, 1963
3. Carlson and others, 1978
4. Ross, 1961
5. Howell, unpublished
6. Albers and Stewart, 1965

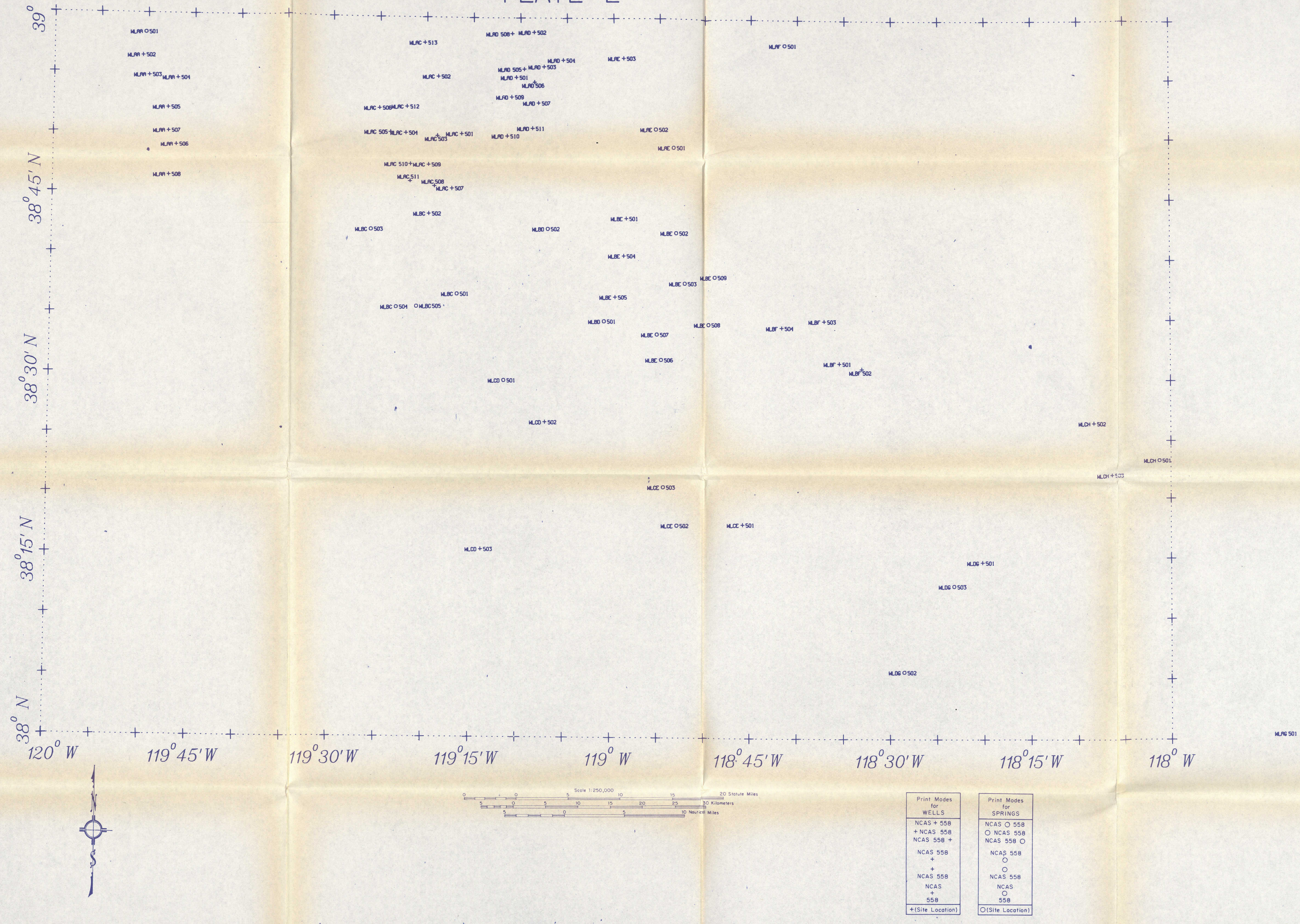
PLATE I-A



WALKER LAKE NEVADA, CALIFORNIA
MINERAL RESOURCES
PLATE 1-B

PLATE 1-B

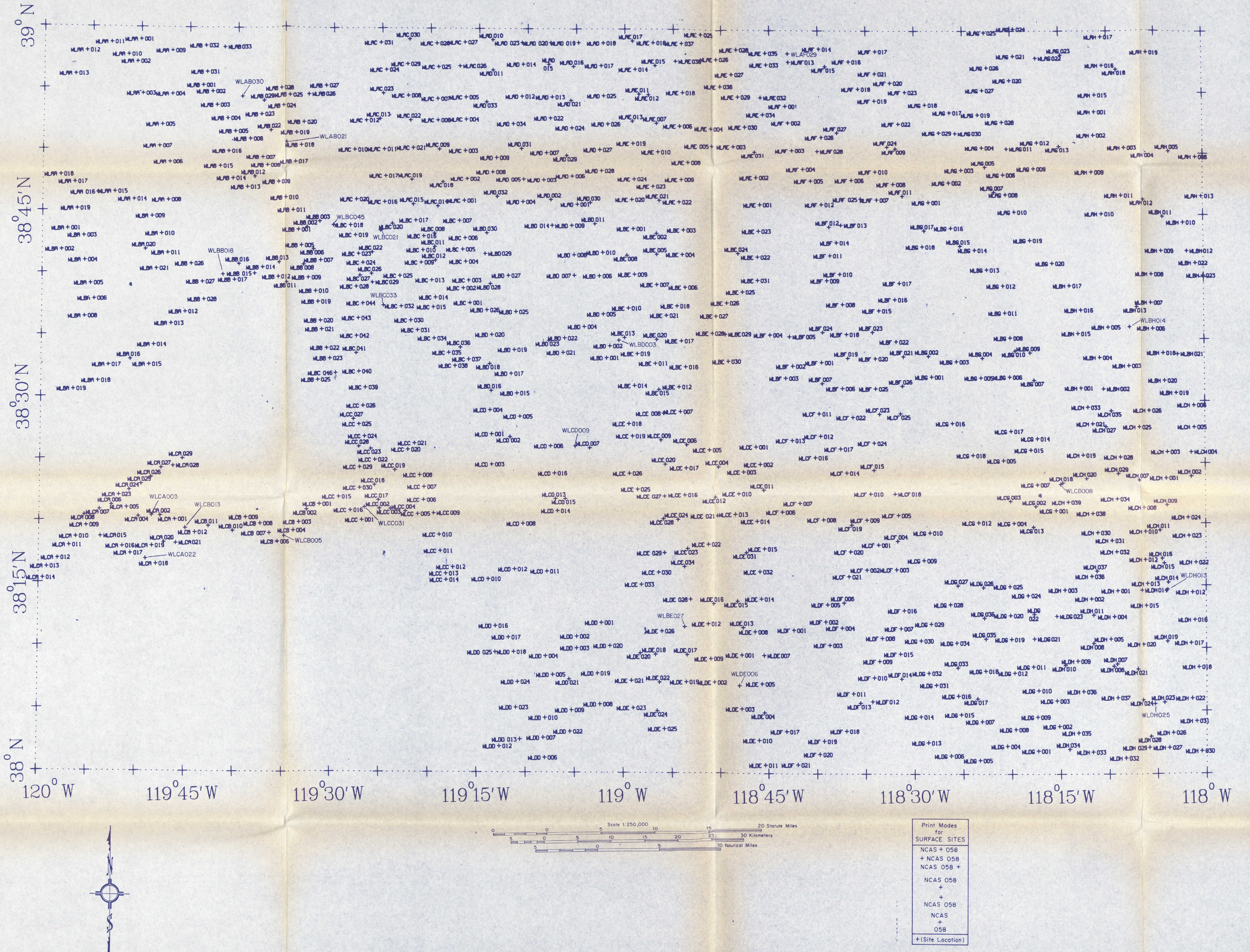
PLATE 2



GROUND WATER SAMPLE SITE LOCATIONS IN THE *WALKER LAKE* QUADRANGLE

PLATE 2

PLATE 2

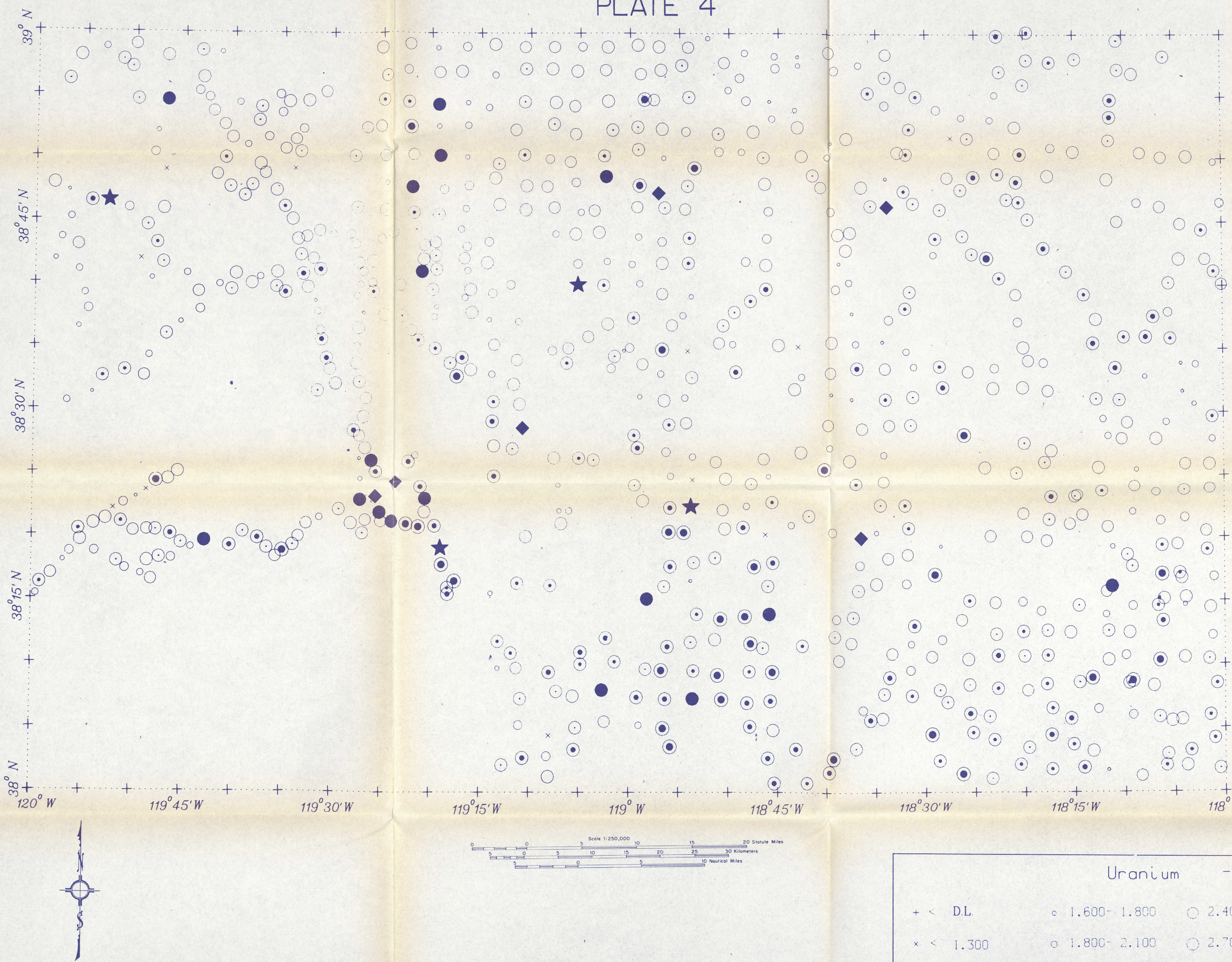


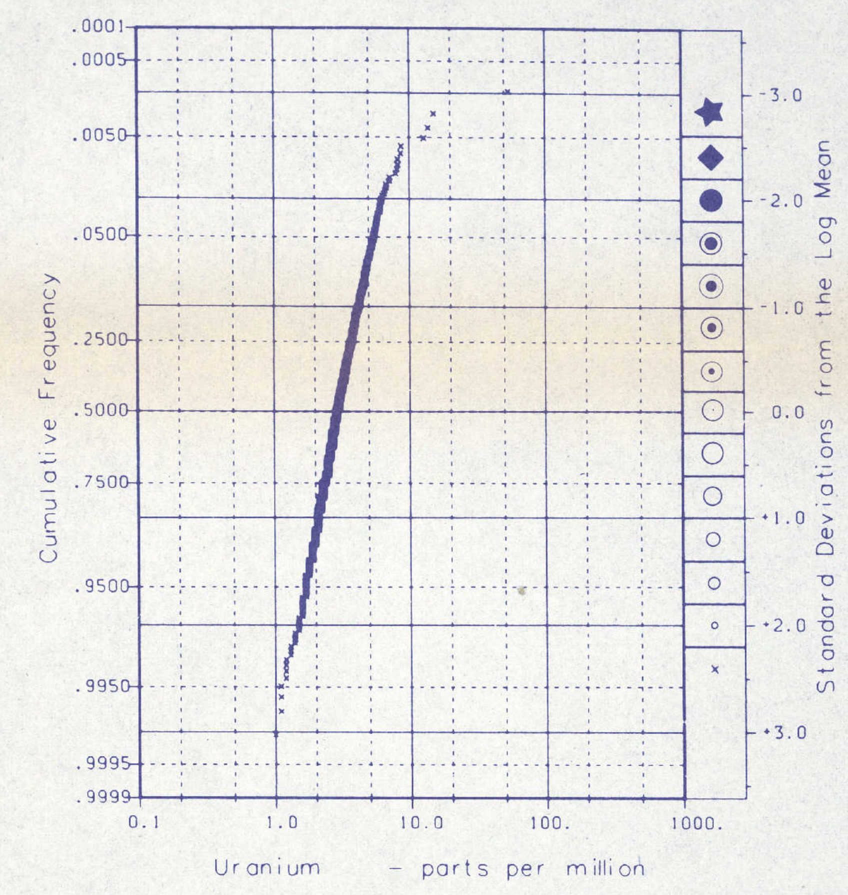
SURFACE SAMPLE SITE LOCATIONS IN THE *WALKER LAKE* QUADRANGLE

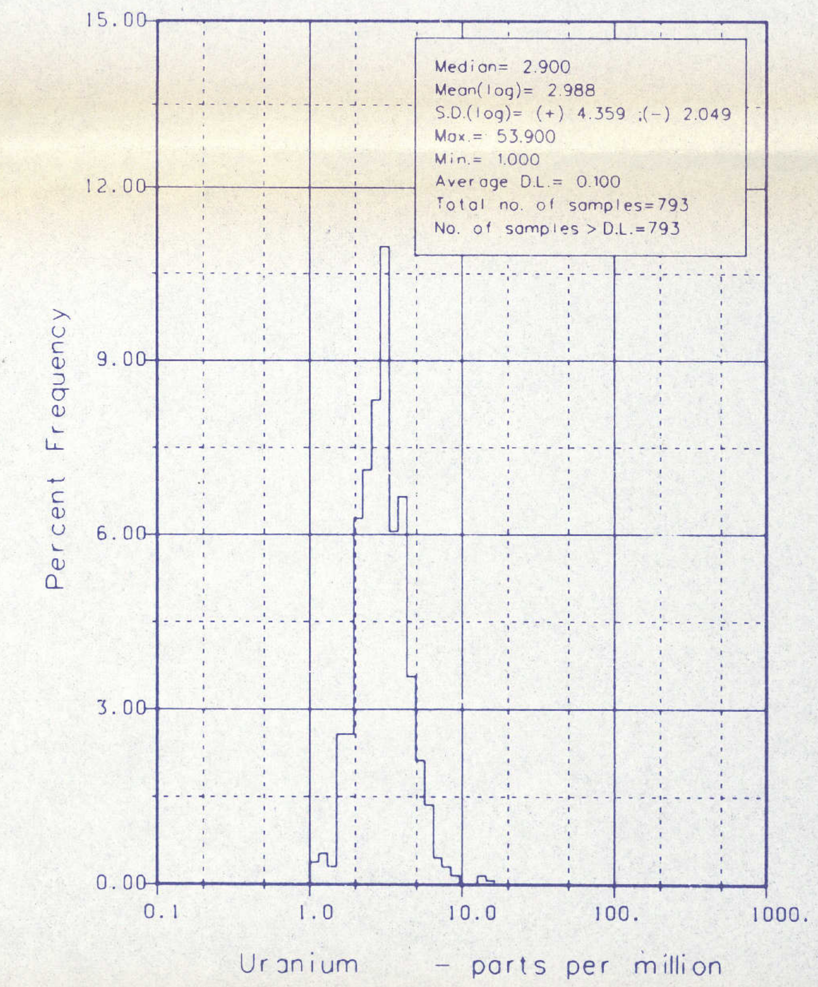
PLATE 3

PLATE 3

PLATE 4







Uranium - parts per million

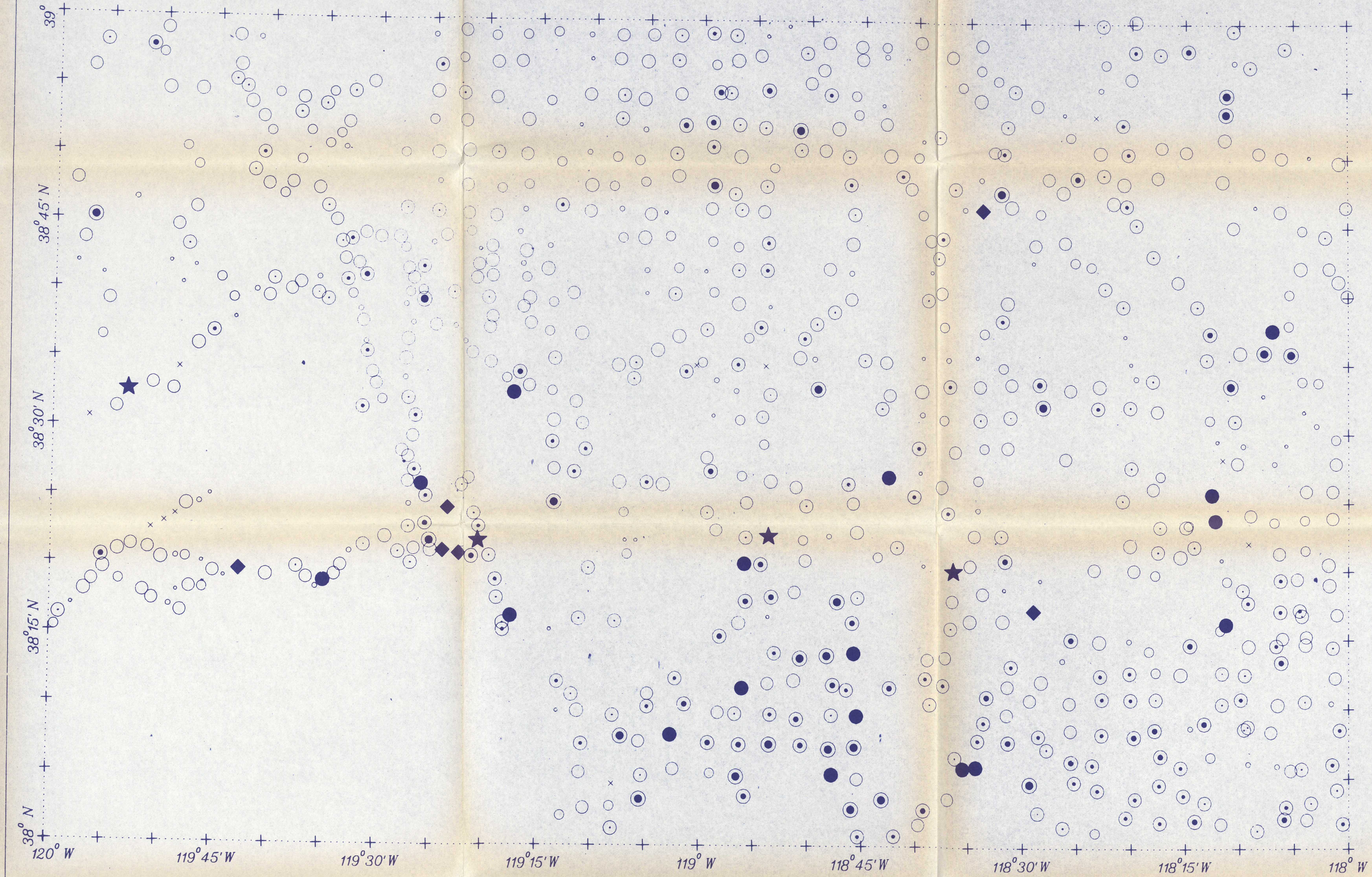
+ < D.L.	∘ 1.600- 1.800	○ 2.400- 2.700	⊙ 3.600- 4.200	● 5.800- 7.200
× < 1.300	∘ 1.800- 2.100	○ 2.700- 3.100	⊙ 4.200- 4.900	◆ 7.200- 8.800
∘ 1.300- 1.600	○ 2.100- 2.400	⊙ 3.100- 3.600	⊙ 4.900- 5.800	★ > 8.800

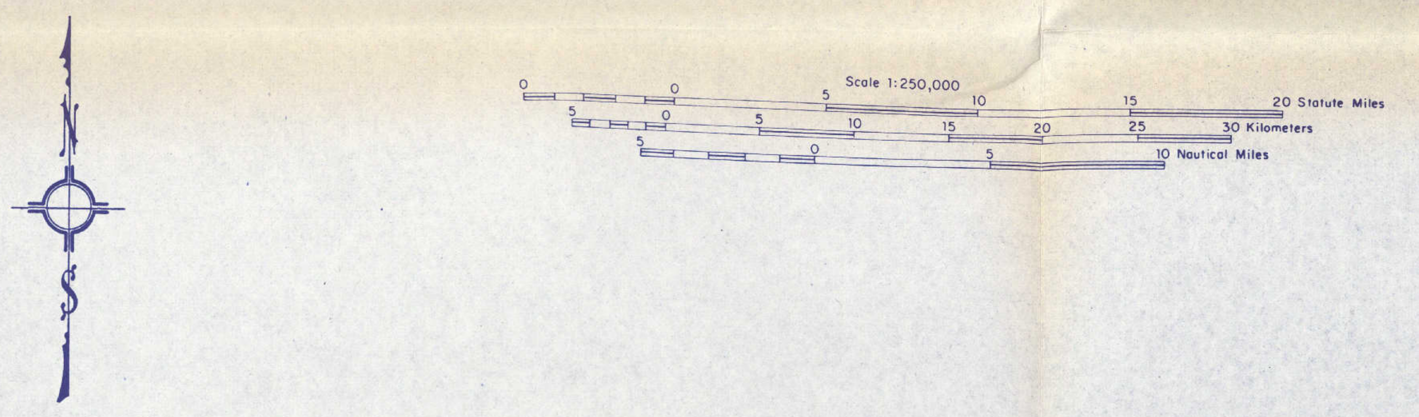
URANIUM DISTRIBUTION IN THE SEDIMENTS OF THE *WALKER LAKE* QUADRANGLE SO FRACTION

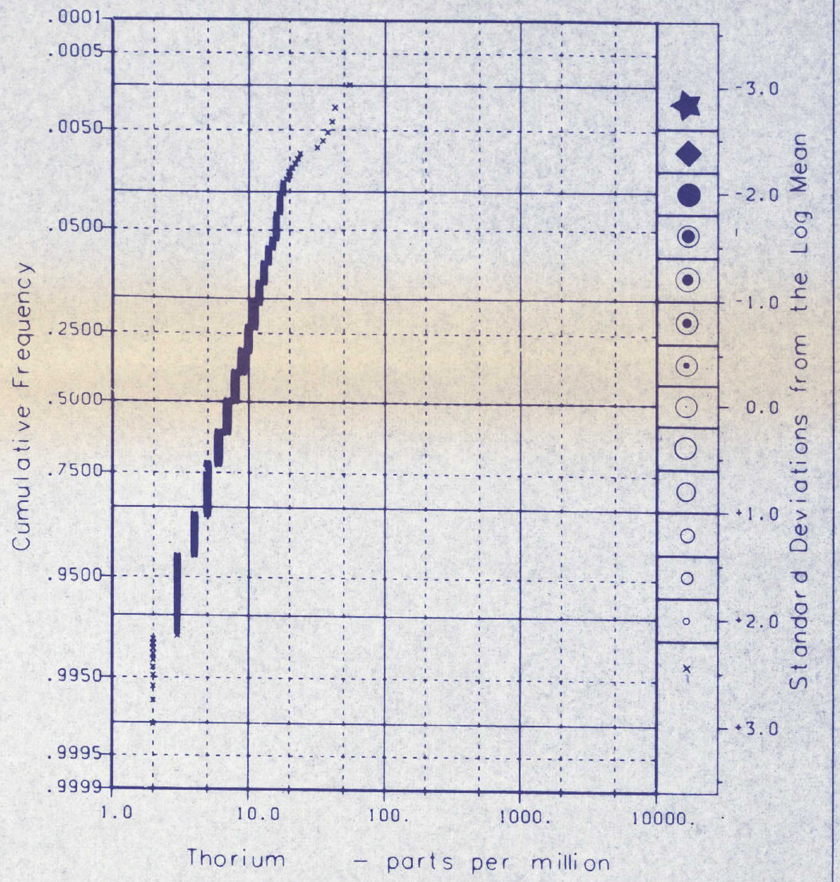
PLATE 4

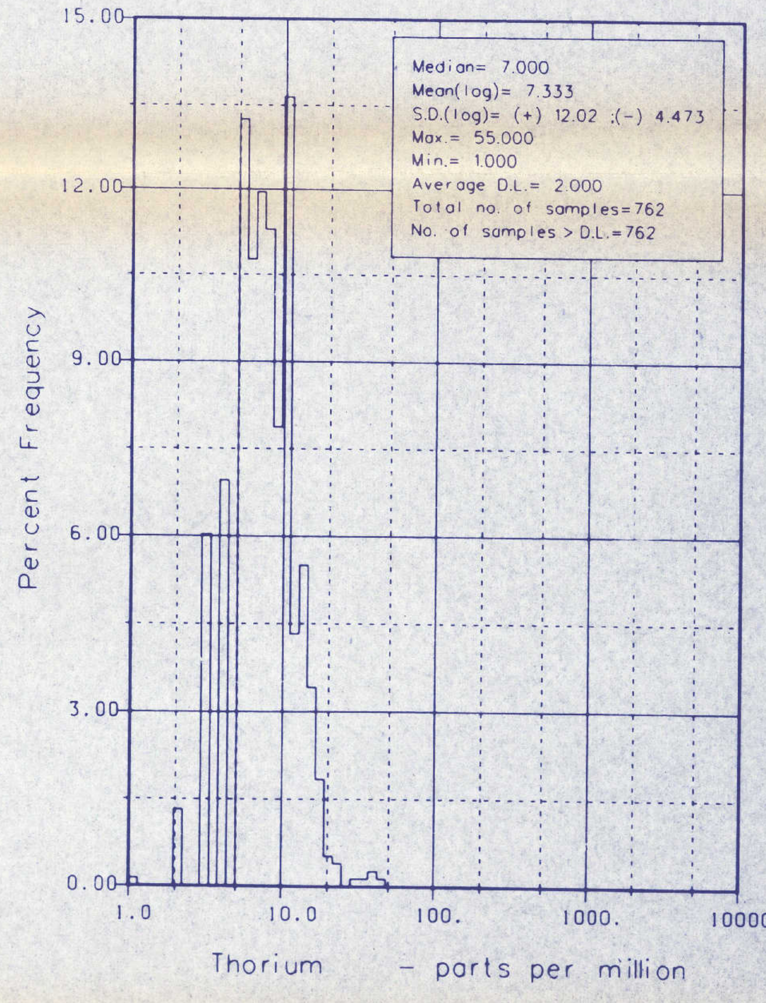
PLATE 4

PLATE 5









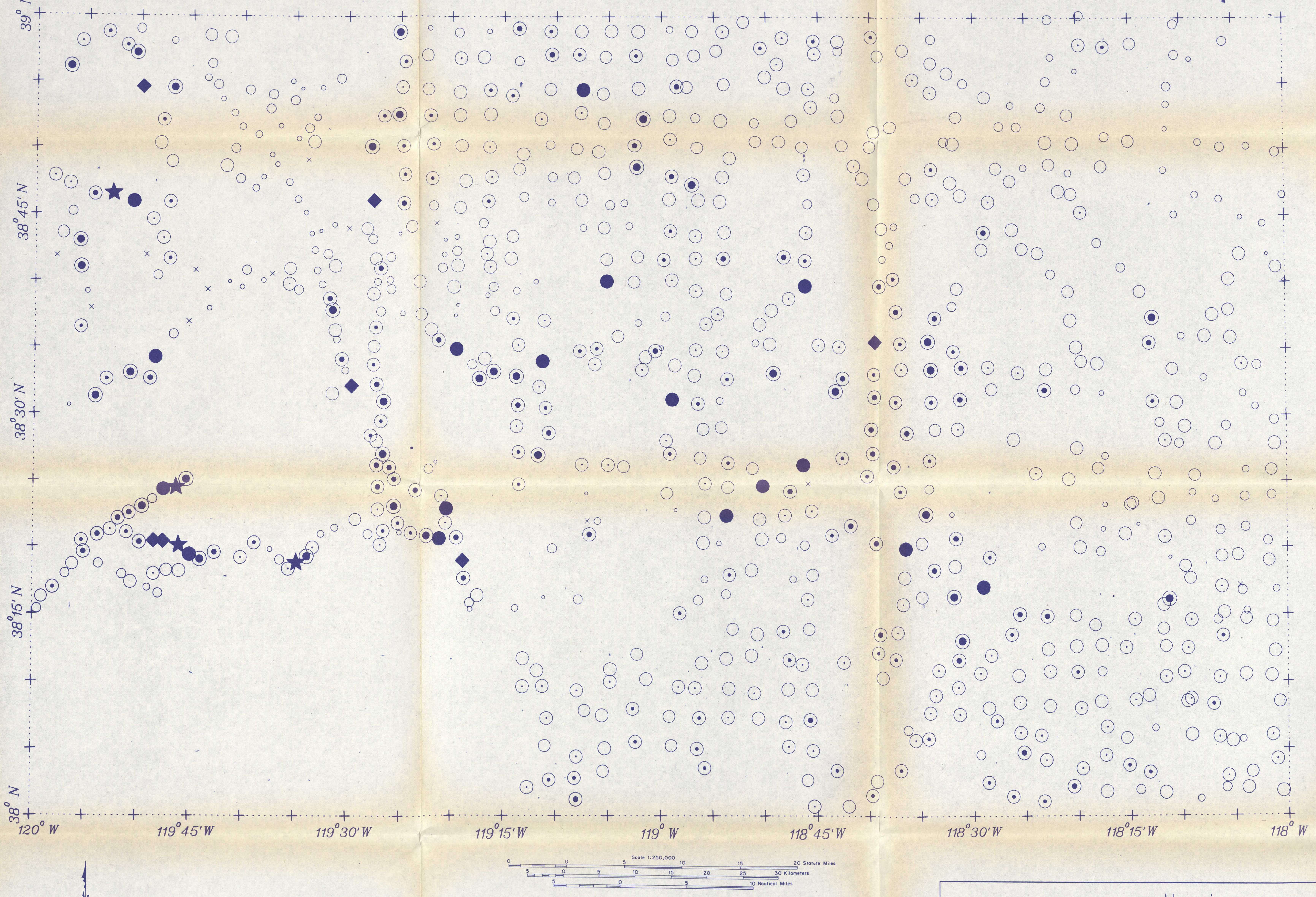
Thorium - parts per million

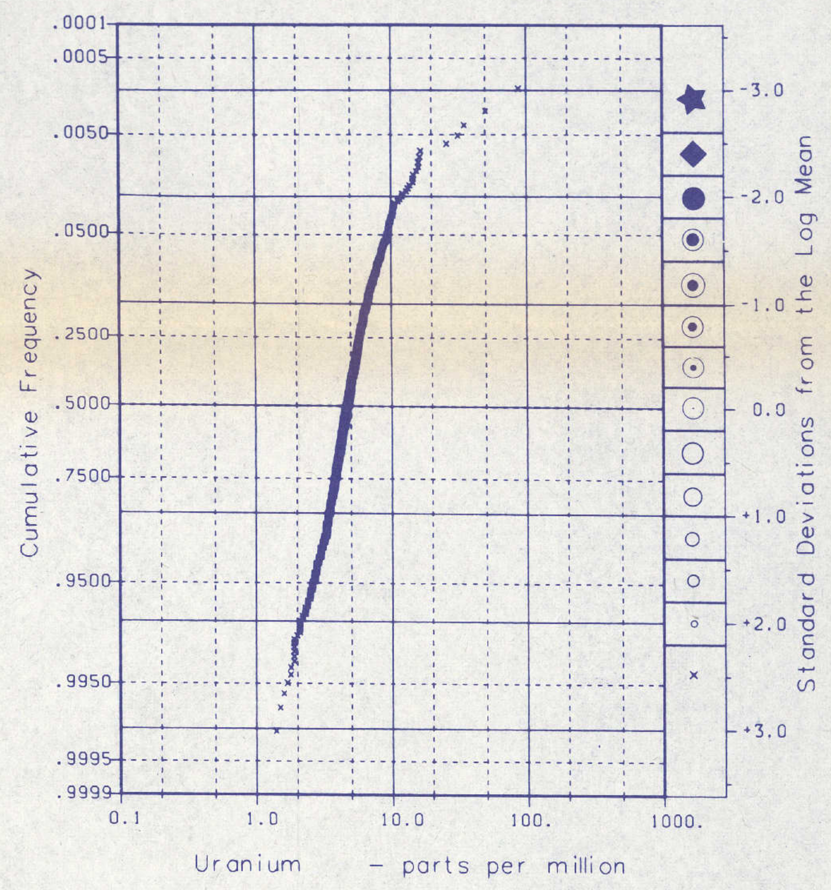
+ < D.L.	∘ 3.0- 4.0	○ 5.0- 7.0	⊙ 10.0- 12.0	● 16.0- 20.0
× < 2.0	∘ 4.0 5.0	○ 7.0- 8.0	⊙ 12.0- 14.0	◆ 20.0- 35.0
∘ 2.0- 3.0	○ 5.0- 5.0	⊙ 8.0- 10.0	⊙ 14.0- 16.0	★ > 35.0

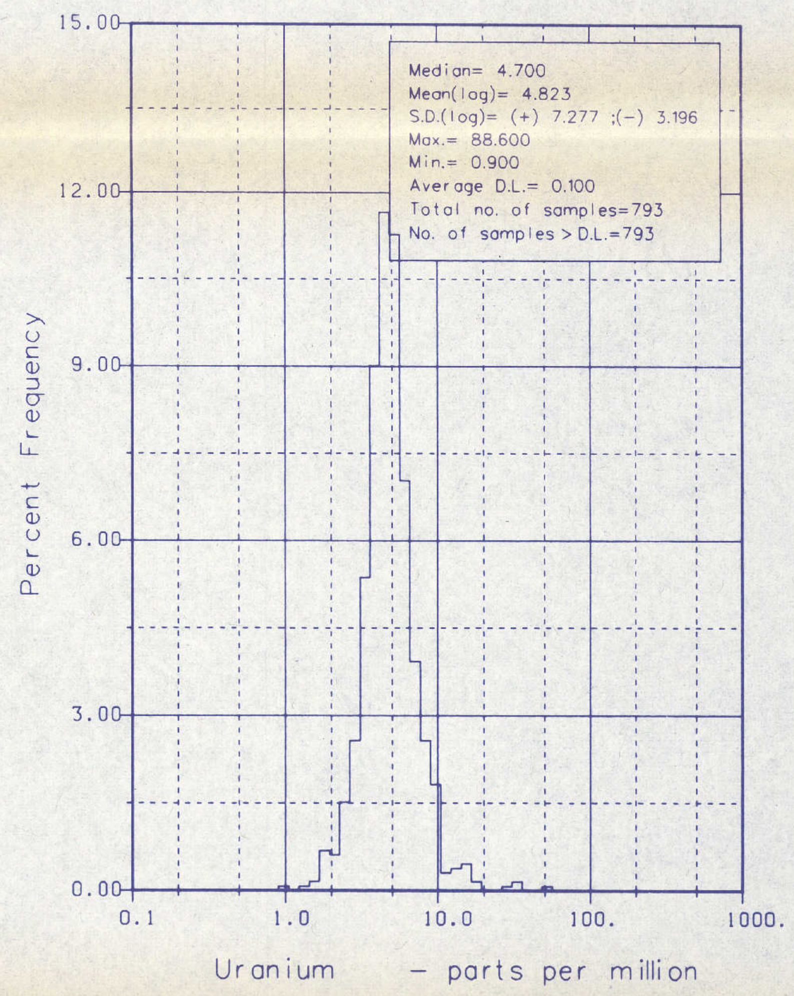
THORIUM DISTRIBUTION IN THE SEDIMENTS OF THE *WALKER LAKE* QUADRANGLE SO FRACTION

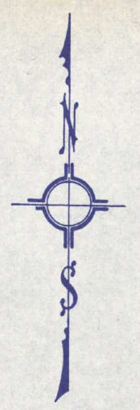
PLATE 5 PLATE 5

PLATE 6









Uranium - parts per million

+ < D.L.	∘ 2.400- 2.900	○ 3.900- 4.400	⊙ 5.700- 6.700	● 10.000- 14.700
× < 1.900	○ 2.900- 3.400	○ 4.400- 5.000	⊙ 6.700- 8.100	◆ 14.700- 26.100
∘ 1.900- 2.400	○ 3.400- 3.900	⊙ 5.000- 5.700	⊙ 8.100- 10.000	★ > 26.100

URANIUM DISTRIBUTION IN THE SEDIMENTS OF THE *WALKER LAKE* QUADRANGLE S1 FRACTION

PLATE 6

PLATE 6

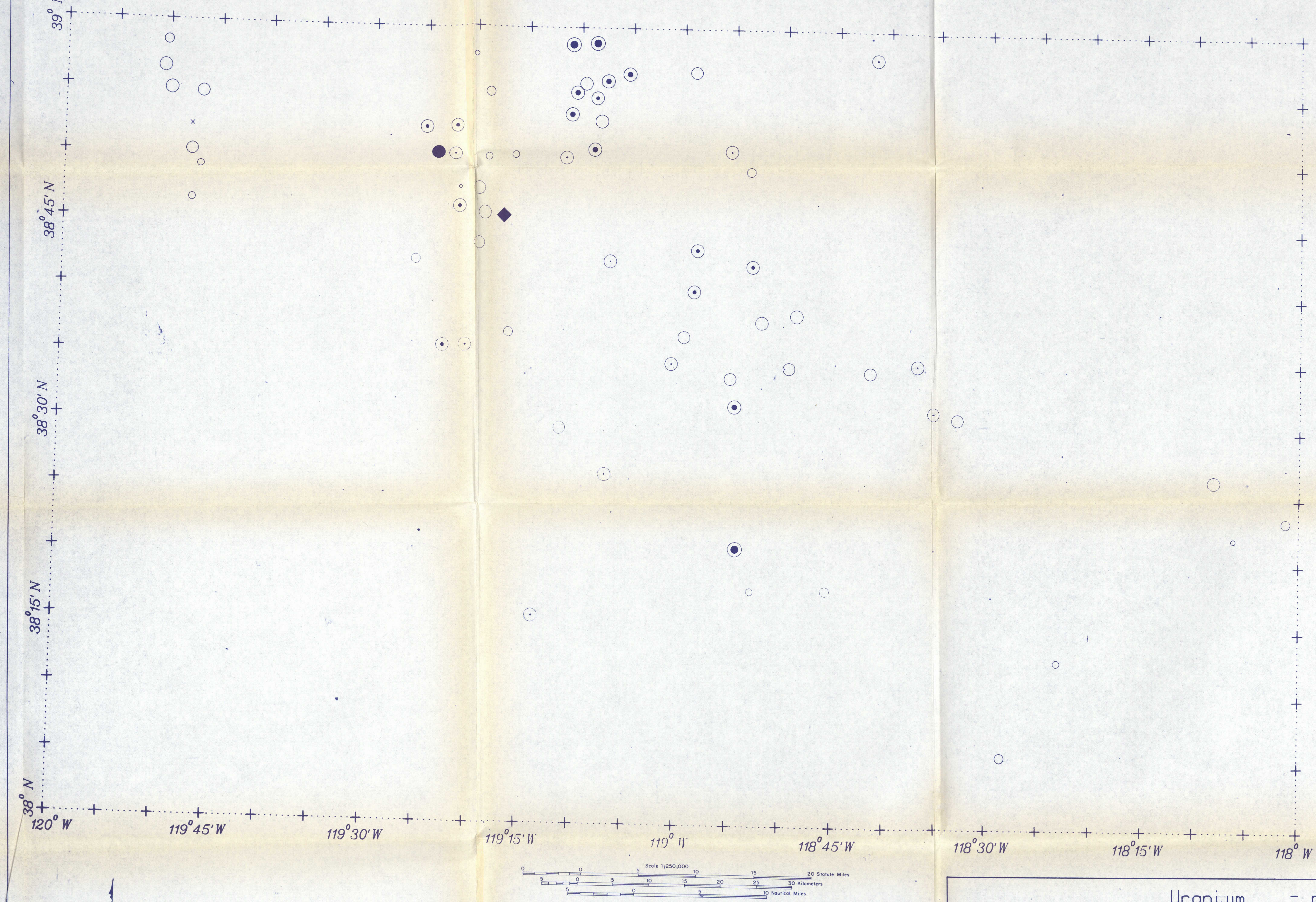
PLATE 7

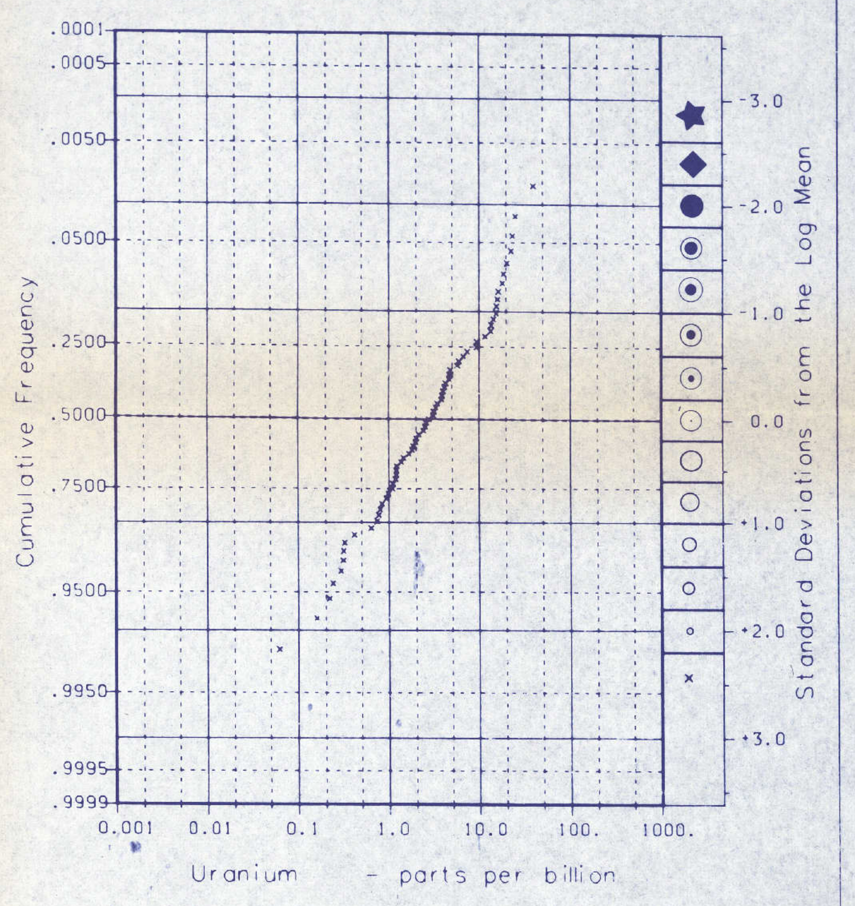
THORIUM DISTRIBUTION IN THE SEDIMENTS OF THE *WALKER LAKE* QUADRANGLE S1 FRACTION

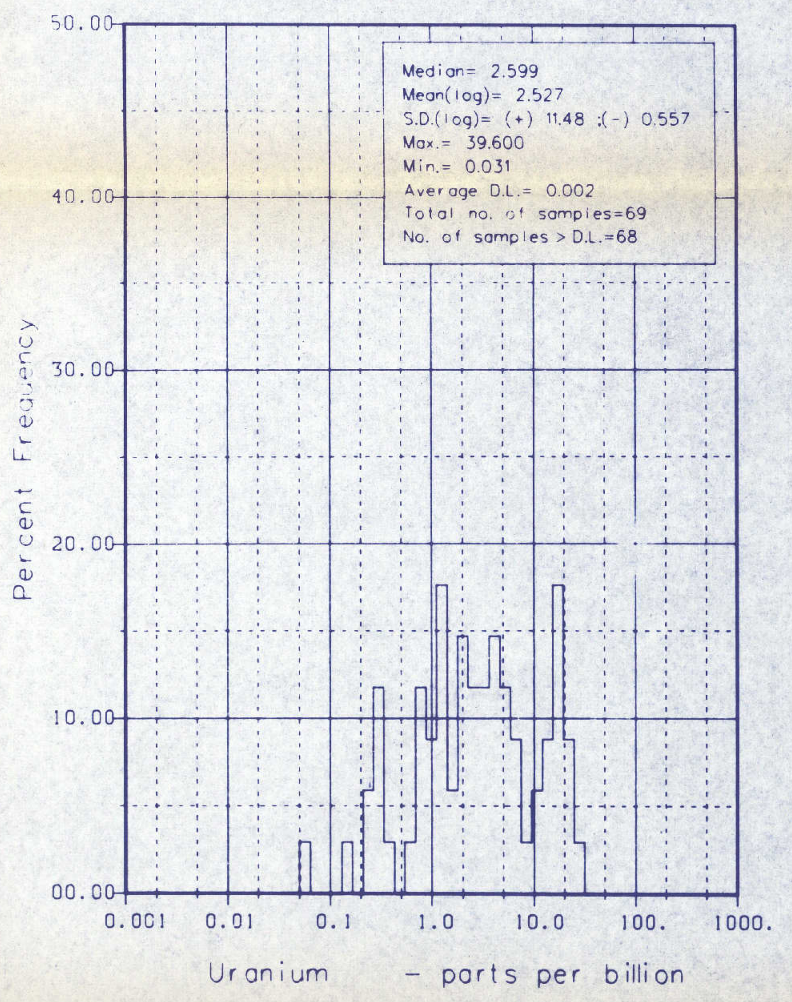
PLATE 7

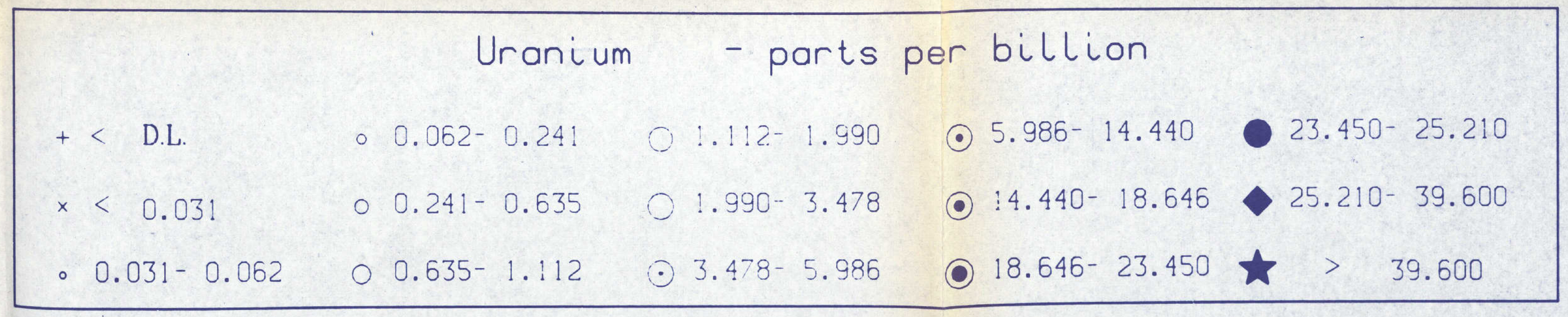
PLATE 7

PLATE 8







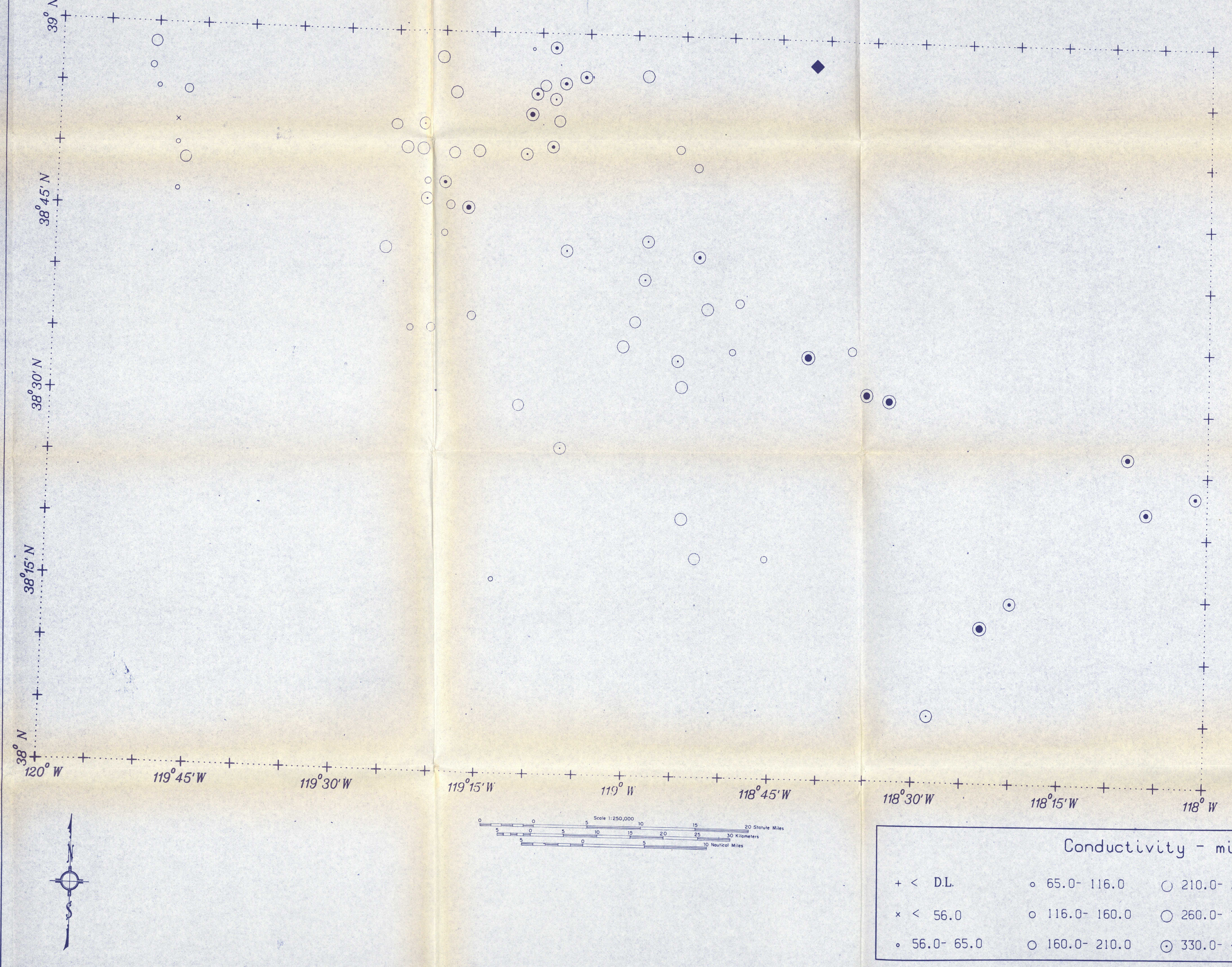


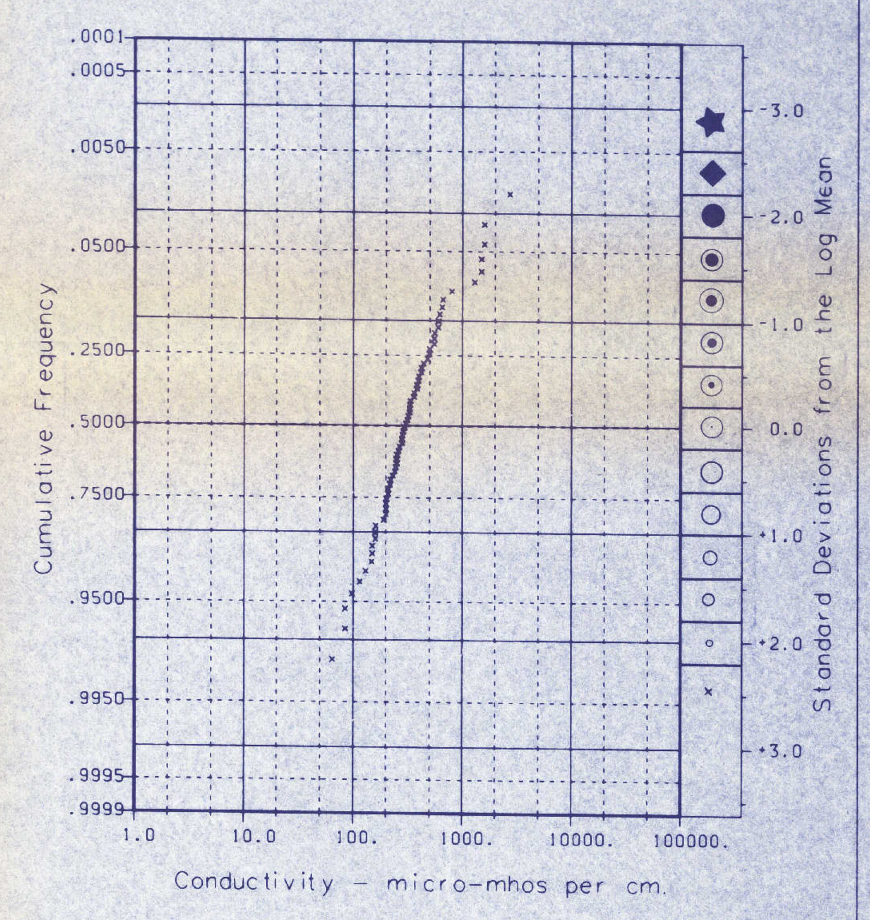
URANIUM DISTRIBUTION IN THE GROUND WATERS OF THE *WALKER LAKE* QUADRANGLE

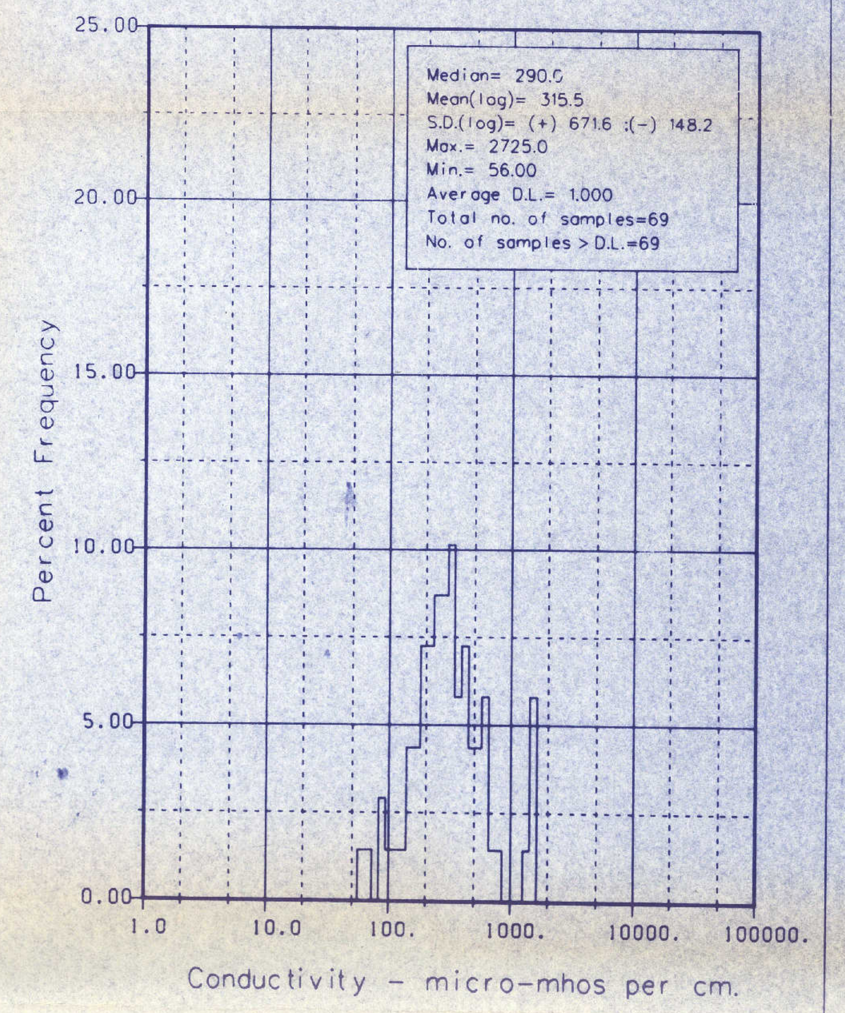
PLATE 8

PLATE 8

PLATE 9







Conductivity - micro-mhos per cm.

+ < D.L.	∘ 65.0- 116.0	○ 210.0- 260.0	⊙ 422.0- 600.0	● 1600.0- 1600.0
× < 56.0	○ 116.0- 160.0	○ 260.0- 330.0	⊙ 600.0- 800.0	◆ 1600.0- 2725.0
∘ 56.0- 65.0	○ 160.0- 210.0	⊙ 330.0- 422.0	⊙ 800.0- 1600.0	★ > 2725.0

CONDUCTIVITY DISTRIBUTION IN THE GROUND WATERS OF THE *WALKER LAKE* QUADRANGLE

PLATE 9

PLATE 9