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AERIAL RADIOMETRIC AND MAGNETIC SURVEY

BRIGHAM CITY

NATIONAL TOPOGRAPHIC MAP

UTAH

PREPARED FOR THE U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO
UNDER SMALL BUSINESS ADMINISTRATION SUBCONTRACT NO. SB0308(a) 77-C-508

WITH
GEO-LIFE, A JOINT VENTURE
BETWEEN
HIGH LIFE HELICOPTERS, INC.
PUYALLUP, WASHINGTON
AND
GEODATA INTERNATIONAL, INC.
DALLAS, TEXAS

Geodata International, Inc.
7035 JOHN W. CARPENTER FRWY.
DALLAS, TEXAS 75247

VOL. 1

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"BRIGHAM CITY NATIONAL TOPOGRAPHIC MAP SURVEY"

ABSTRACT

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Brigham City National Topographic Map NK12-7 is presented in Volume I and II of this report. The airborne data gathered is reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

SECTION I

INTRODUCTION

A. GENERAL

1. Area Surveyed

Geo-Life, a joint venture between High Life Helicopters, Inc., Puyallup, Washington, and Geodata International, Inc., Dallas, Texas., conducted an airborne gamma ray and total magnetic field survey during the period April 28 to July 10, 1978. The survey covered a region of the state of Utah identified as the Brigham City National Topographic Map NK12-7. The specific area of this report as outlined on Figure 1 was surveyed from an aircraft using large-volume radiation detectors with associated airborne electronic equipment. Each map line was flown in an east-west direction with an average length of 103 miles, and each tie line was flown in a north-south direction with an average length of 69 miles. Map lines and tie lines were surveyed using a Lama helicopter.

The Brigham City NTMS report is separated into two volumes, Volume I giving the description of the program and results, and Volume II presenting the flight line profile data and statistical analysis results.

2. Summary of the Location, Geology and Physiography of the Brigham City Map Sheet

The Brigham City National Topographic Map Sheet area is in northwestern Utah and a minute part of southern Idaho. The area is bounded by latitudes 41°00' and 42°00' north and longitudes 112°00' and 114°00' west. The landscape is part of the Basin and Range Physiographic Province; however, the eastern margin of the area is peripheral to the Rocky Mountain Physiographic Province. The most prominent basin area is presently occupied by the Great Salt Lake and by the Great Salt Lake Desert. Surficial sediments, of Quaternary age, that are related to past or present inland salt lakes cover more than fifty percent of the map area. The waters of the Great Salt Lake occupy much of the eastcentral portion of the map area. Paleozoic, Mesozoic and Tertiary geologic units are underlain by Precambrian basement rocks, and in places, by later Precambrian marine sediments. Most of the Paleozoic marine sediments were deposited in a miogeosyncline. Cambrian and Ordovician strata are well represented in the area, as are Mississippian, Pennsylvanian and Permian units; the Mesozoic Era is not well represented. The Mesocordilleran Highlands were formed during the Early Mesozoic, and much of the map area underwent prolonged denudation during Middle Triassic to Late Cretaceous times. The Cenozoic Era, was one of structural unrest and cataclysmic events. Eardley (1969) classifies the tectonic events of the Late Mesozoic and Cenozoic into Laramide structures and Basin and Range structures. Limited intrusive activity and more extensive volcanism occurred during the Cenozoic. The intrusive activity may have been associated with the Laramide Orogeny. The Pleistocene stratigraphy of the area is mainly associated with Lake Bonneville and its predecessors. The map area does not appear to have any well-developed, high-grade uranium ore concentrations. However, certain units in the Phosphoria Formation are slightly uraniferous.

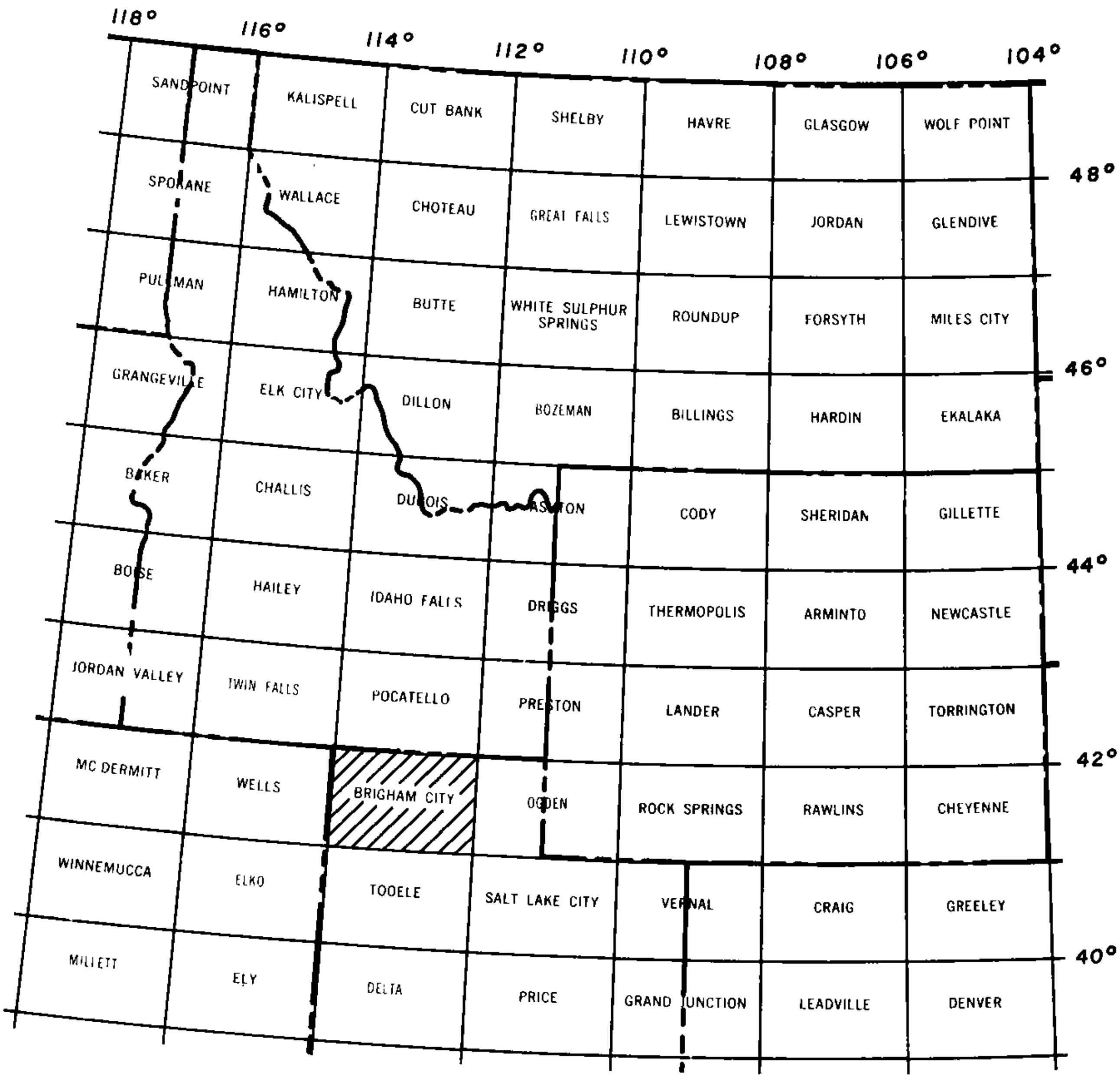


Fig. 1. Index Map Showing Area Surveyed

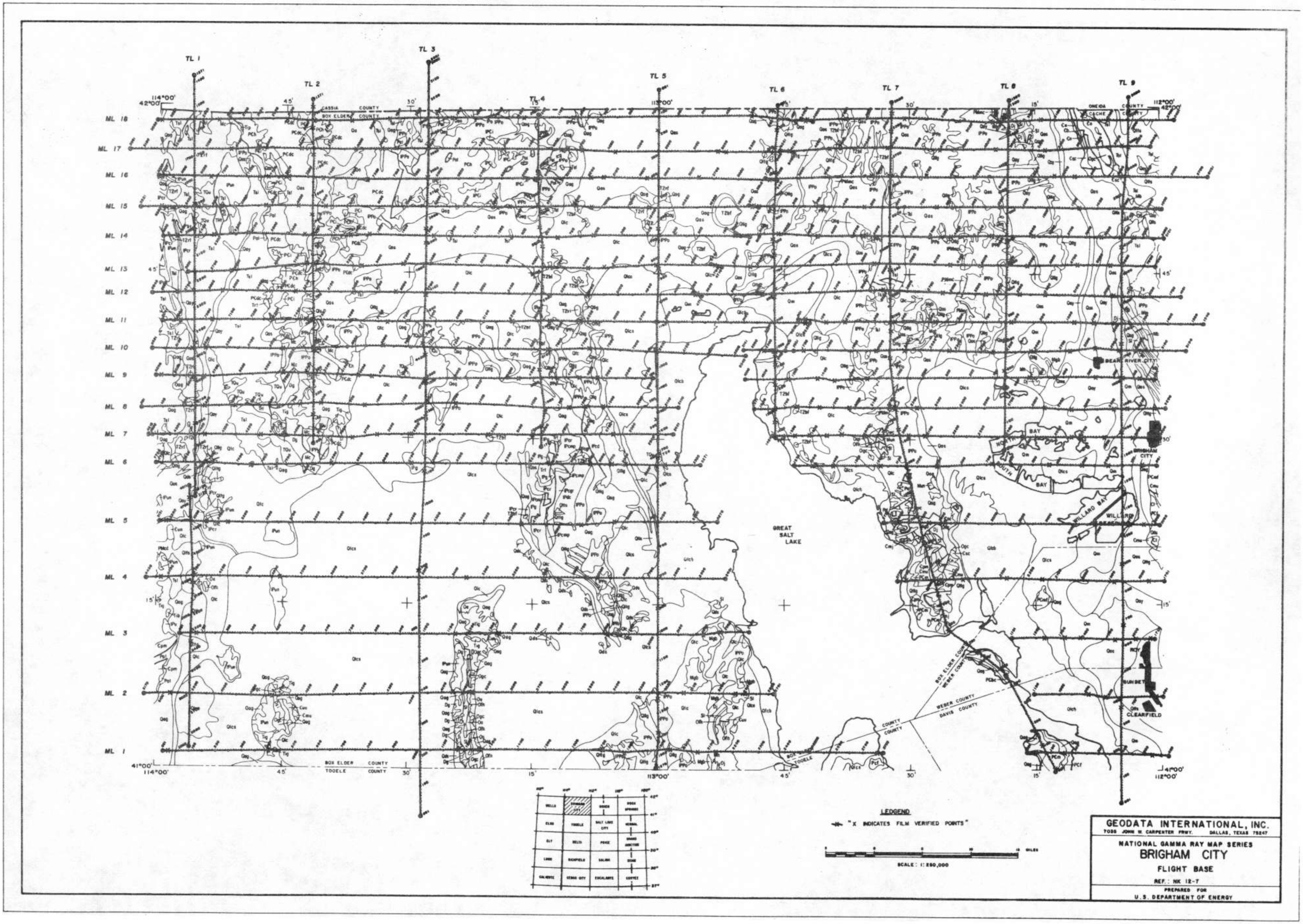


Figure 2. NTMS Indicating Flight Line Location

B. OPERATIONAL PROGRAM

The airborne data gathered were reduced using ground-based computer facilities to give the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units indicated from the developed geologic map. Results of analyses of these field data are presented as profile plots of the gamma radiation and earth's magnetic field. The surveyed area of Figure 1, which indicates latitude/longitude position, has been based according to the National Topographic Map Series (NTMS) which covers the United States with 1^{o} latitude/2^{o} longitude sheets. The topographic maps have a scale of approximately 1 inch = 4 miles. Each final base map is an overlay of the NTMS base map from which certain geographic data have been transposed, and includes the available geologic data. Each final anomaly map has the surveyed flight lines superpositioned with the standard deviations of each fifth data point relative to the average value within each geologic unit as determined for each NTMS map. These anomaly maps are identified as National Gamma Ray Map Series Maps (NGRMS).

Computer profile plots of the gamma radiation and magnetic field data have been created for all surveyed map lines and tie lines. Each line has indicated on the profiled line the location of each geologic type as a function of record number. The statistical distribution of data within each geologic unit has been calculated and is included. The scale of the profile data in this final report is 1:500,000 and the scale of the NGRMS is both 1:250,000 and 1:500,000. The bound final report containing the 1:500,000 profile data also contains the flight line map, geologic base of the pertinent NTMS and the NGRMS maps indicating the standard deviations at the scale of 1:500,000. Two sets of profiled data for each line flown are included with one set displaying magnetic field, gamma radiation and other data. The second set includes only flight line magnetic field, temperature, pressure, and altitude data, plus magnetic field data as measured at a base station. Each set contains the flight line location relative to the geologic map. All data have been located giving latitude and longitude positions in fractional degrees as made possible from visual spotting, photographic recording of the aircraft location, and from VLF/OMEGA guidance of the aircraft and recording of location on magnetic tape. Data have been acquired and processed according to the data flow shown in Figure 3.

The magnetic data tapes containing (1) raw data, (2) the single record reduced data, (3) the statistical analysis data, and (4) the magnetic field data are converted to the EBCDIC format and retained for filing within the USDOE permanent data bank.

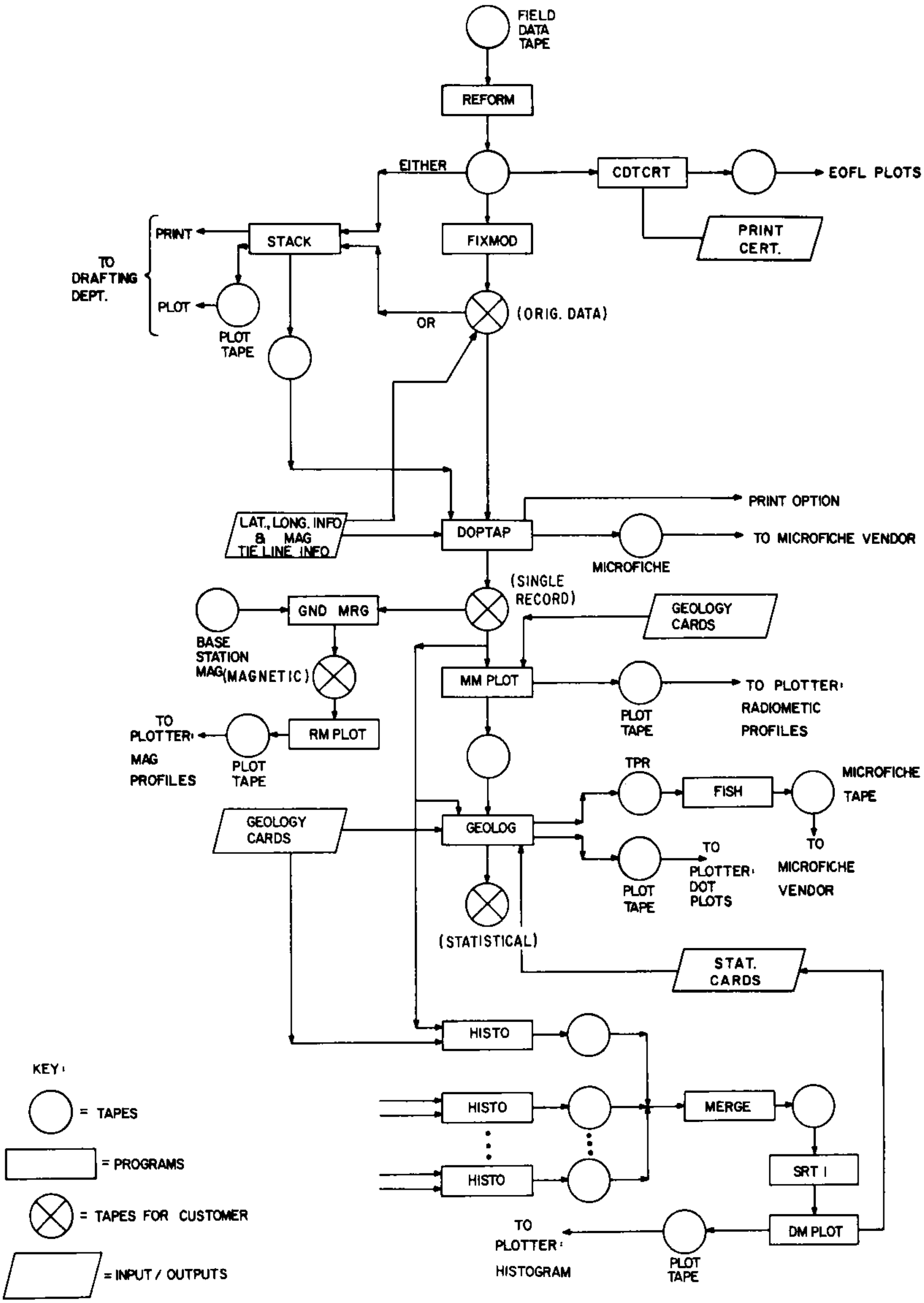


FIGURE 3. DATA FLOW DIAGRAM

This final report includes a general geologic description of the area, including descriptions of the various geologic units and correlates the airborne data to the geologic units as provided by the geologic maps. Also included is a frequency distribution study of the data as a function of the geologic units encountered over the NTMS area including the tie line data.

This report also consist of an interpretative discussion of the area surveyed and includes all single record data and averaged record data listings on MICROFICHE.

SECTION II

THE GEODATA AIRBORNE SYSTEM

A. GENERAL

The Geodata Airborne System is mounted in an Aerospatiale Lama helicopter shown in Figure 4. The functional block diagram is shown in Figure 5. Eight 4" x 4" x 16" Na(Tℓ) detectors are to be used to measure spectrally the surface-emitted gamma ray intensity at an aircraft elevation of about 400 feet above the earth's surface. Two (2) 4" x 4" x 10" Na(Tℓ) detectors, which are largely shielded from the surface radiation, are used to measure the atmospheric ^{214}Bi radiation.

Two detector packages, each containing four of the eight 16" long detectors and each with 1,024 cu.in. of NaI(Tℓ), are used to measure gamma radiation from the surface. The total detector volume is 2,048 cu.in., and a $V/v \geqslant 20.0$ at an aircraft speed of 102.4 mph, (V = detector volume, in.^{3}; v = aircraft speed, mph).

The system block diagram of Figure 5 shows the center of the system to be the Digital Equipment Corporation LSI-11 computer system. The 2,048 cu.in., 4π solid angle, detector data are accumulated for each one-second data integration period in a manner giving no readout dead time onto magnetic tape. A single magnetic tape is used to record total spectral data and all peripheral data. Analog presentation of the total gamma ray intensity, magnetic field and altitude data are plotted onto multitrack paper as data are gathered allowing immediate examination for data quality. A spectral presentation giving the sum of all one-second data sets is created by the ground-based computer for each flight line (EOFL) as quality control, Figure 6. Spectral data from the unshielded (4π) detector array are accumulated each 1.0 second, and spectral data from the shielded (2π) detector array are accumulated each 10.0 seconds. Data from the shielded detector are used to determine the concentration of atmospheric ^{214}Bi which allows calculation of the surface-emitted ^{214}Bi values before altitude corrections. All data are then corrected to a constant aircraft altitude above the surface of 400 feet. A highly accurate radar altimeter, the Collins ALT-50 system, makes measurement during each second. Automatic digital gain calibration of the detector arrays is accomplished by stabilizing on the $^{208}T\ell$ photopeak by placing the 2.615 MeV photopeak into channel 224.

A proton precession magnetometer having a 0.25 gamma readout resolution and less than ±2.0 gamma noise envelope is also sampled once each second giving a measurement of the total intensity of the earth's magnetic field. The sensor is carried as a "bird" on a 100-foot cable to minimize the magnetic effects of the helicopter. A permanent record of flight location is also made using 35mm film which records

Figure 4. Aerospatiale Lama Helicopter

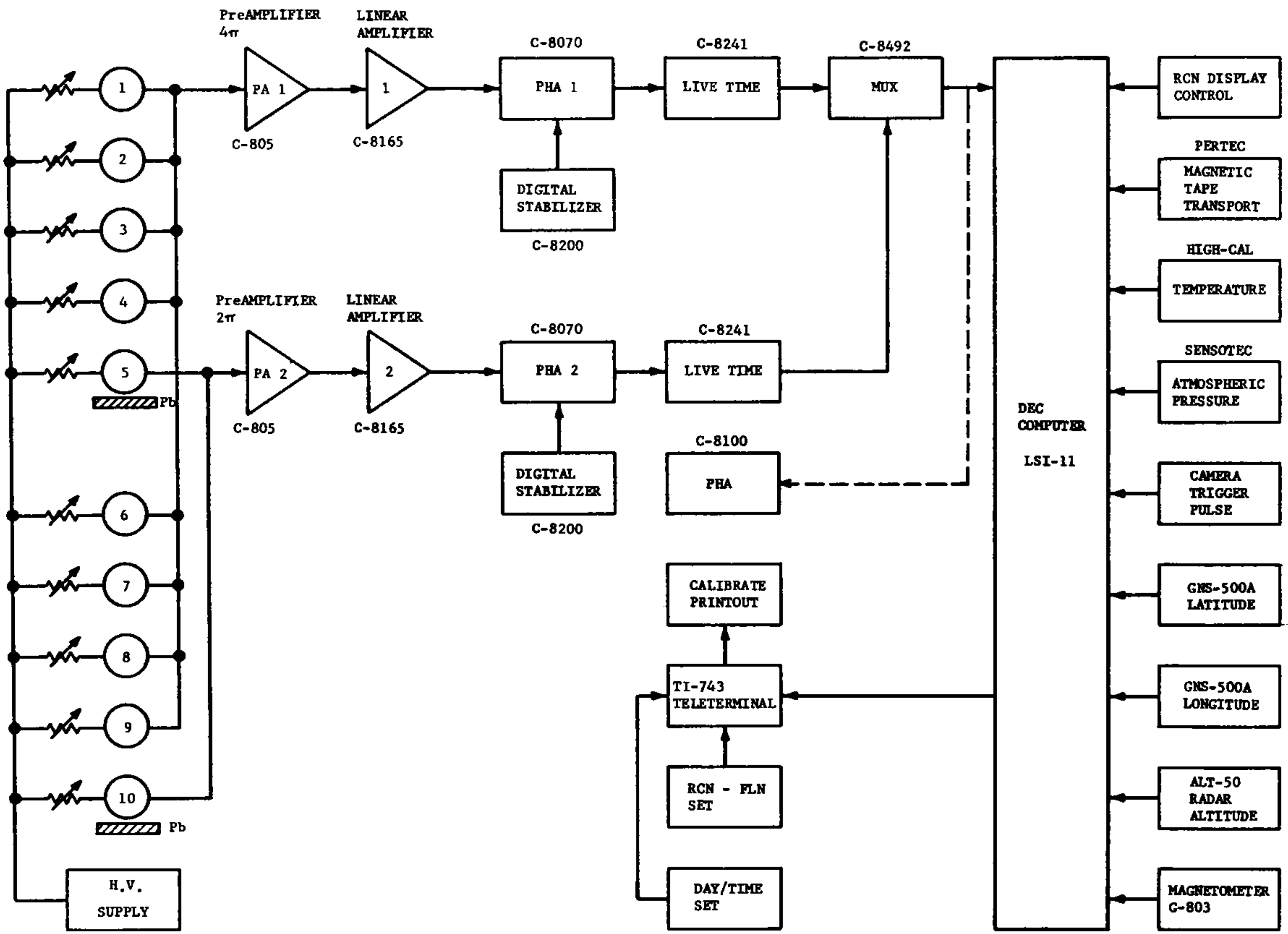


Fig. 5. Functional Block Diagram

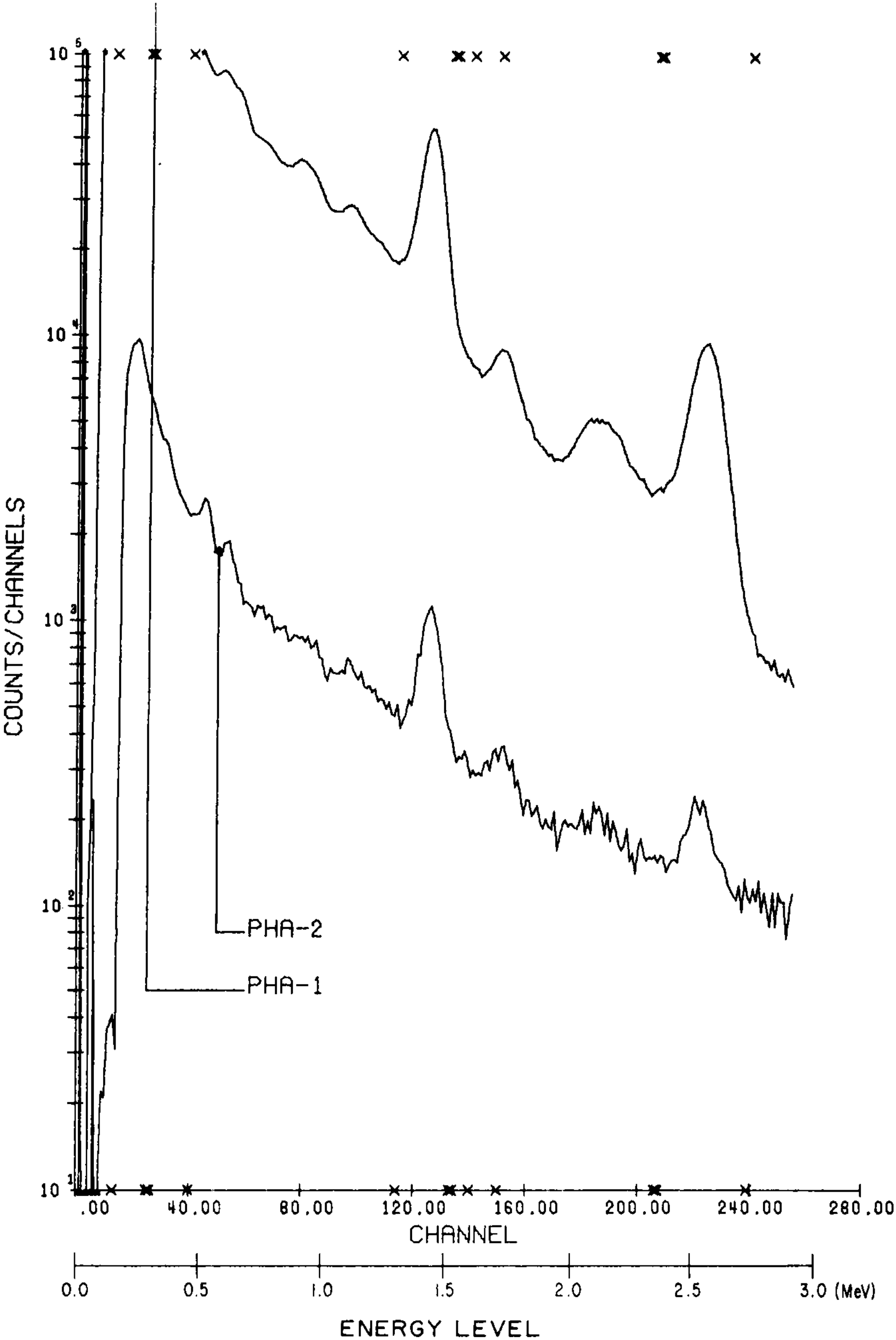


Figure 6. Typical End-of-Flight Line Spectral Plot

a continuous recoverable track with 20% frame overlap at an elevation of 400 feet. Position data from the Global Navigation encoding of latitude and longitude is placed onto magnetic tape each second. The record number-of-the-day along the flight line is displayed during flight and key aircraft positions are marked on the flight map with their appropriate record number.

The attenuation of gamma radiation is calculated using equations accounting for air density and uses experimentally determined values for linear attentuation coefficients. The energy region 3 MeV to 6 MeV is used to allow cosmic events to be removed from the data in the energy range 0-3 MeV. Energy resolution of the ^{137}Cs 662.0 keV photopeak was 9.5% or better for each detector. The system resolution is 11.1%.

The airborne equipment has three basic operating modes: (1) CALIBRATE, which allows proper gain calibrations of the radiation detectors to be set; (2) OPERATE, which allows data to be received, reduced and recorded, and (3) PLAYBACK, which allows the operator to examine the newly acquired data.

B. FLIGHT RECOVERY METHODS

Visually recorded data and photographically recorded data have been used to locate the flight line position. The Global Navigation GNS-500A is used to maintain the aircraft on flight line with the latitude and longitude data being recorded on magnetic tape to assist in flight line location. These lines have been positioned by many locations as a function of record numbers. These data are computer plotted giving the flight path as a line of dots, each "dot" representing every fifth record location, and each "circle" representing every 50th record location. Figure 7 indicates the computer plot of a typical map line. These data are then transferred to form the flight line base shown in Figure 2. Location points used to position the flight line at least every 10 miles are shown on the flight line map as an "X".

C. DATA REDUCTION

The processing flow chart representative of the work performed for this survey is shown in Figure 3. The original field data tapes contain the various tag words, 4π and 2π spectral data for each one second along the flight line. The REFORM program sums the proper energy intervals of the spectra for each second and produces a trailer record for each line which contains the accumulated 4π and 2π spectra for the line. The CDTCRT is a data certification program which is run immediately upon receipt of the field data tapes and produces the EOFL spectral plots, Figure 6. The program identification and function are given as:

PROGRAM	FUNCTION
REFORM	Produce energy group sums and EOFL spectra.
FIXMOD	Primary processing for matrix reduction, BIAIR computation, live times, background and altitude correction.

Figure 7. Computer Presentation of Typical Map Line

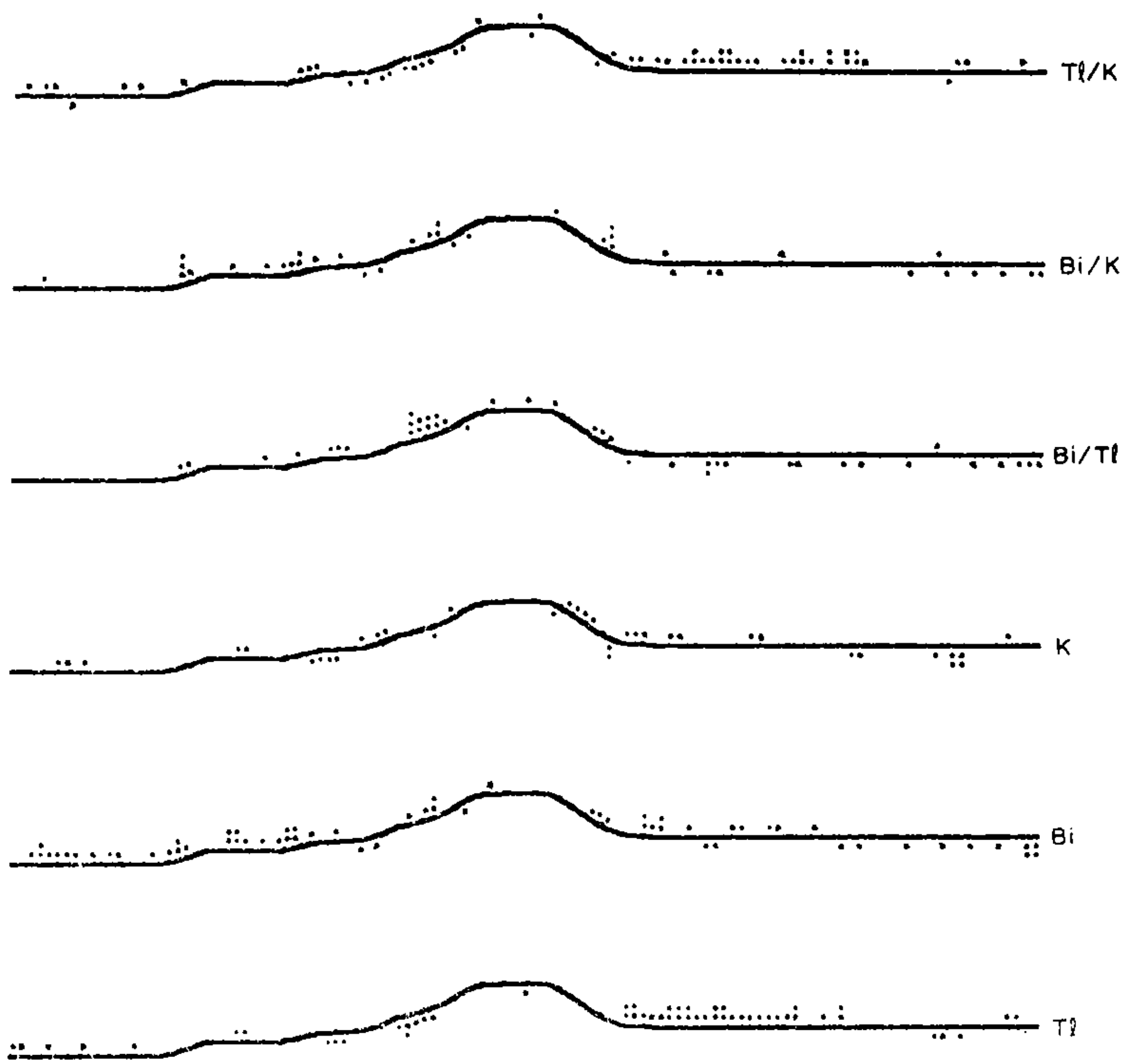


Figure 8. Typical Map Line Showing Statistical Deviations

STACK	Flight path recovery to produce plots of actual paths at a scale of 1:250,000.
DOPTAP	Single record processing with latitude/longitude, IGRF and single point statistical adequacy computation. Produces microfiche.
MMPLT	Averaged record processing with averaged statistical adequacy computation. Produces radiometric stacked profiles plot tapes.
GNDMRG	Merges aircraft magnetometer and ground magnetometer in proper time sequence and transfers temperature, pressure and altitude information.
RMPLT	Produces tapes for magnetometer stacked profile plots.
GEOLOG	Produces averaged value microfiche with geology and plot tape for standard deviation "dot plots" related to geologic type.
HISTO, MERGE	Programs preliminary to obtaining the histograms as a function of geologic type for the entire area.
DMPLOT	Produces plot tape for the area histograms.

As stated in the above list of program functions, the FIXMOD program performs the primary processes for determining the reported eTh, eU and K counting rate associated with the earth's surface as corrected to 400 feet above the surface. For this reason, the analytical work of this program is described in more detail below.

Each one second of 4π spectral data is summed by the REFORM program according to the following energy intervals:

Cosmic:	3.0	to	6.0 MeV
^{208}Tℓ photopeak	2.410	to	2.796 MeV
^{214}Bi photopeak	1.660	to	1.860 MeV
^{40}K photopeak	1.357	to	1.556 MeV

In general, these raw sums contain counts not only from ground sources, but also from aircraft background and atmospheric radioactivity. To determine the counts in the energy intervals which are caused only by the isotope associated with the interval, a 4 x 4 matrix method is used. This matrix may be formed through the use of a standard cosmic spectrum, plus the Walker Field Pad determinations of α, β, γ, and f, or from four standard spectra representing respectively cosmic, thorium, uranium, and potassium pure spectra at a 400 foot altitude.

This matrix multiplication is represented by:

$$\begin{bmatrix} A_{11} & A_{12} & A_{13} & A_{14} \\ A_{21} & A_{22} & A_{23} & A_{24} \\ A_{31} & A_{32} & A_{33} & A_{34} \\ A_{41} & A_{42} & A_{43} & A_{44} \end{bmatrix} \bullet \begin{bmatrix} COS \\ TL \\ BI \\ K \end{bmatrix} = \begin{bmatrix} MCOS \\ MTL \\ MBI \\ MK \end{bmatrix}$$

where the A_{ij} are the elements of the 4 x 4 matrix; the column matrix on the left represents the four raw data sums and the column matrix on the right is the counts in each energy interval caused only by the indicated isotope. These matrix results counts are for the measured live time. To obtain the counts per second, it is necessary to divide by the live time, LTC1, thus:

MCOS/LTC1 = COS1
MTL/LTC1 = TL1
MBI/LTC1 = BI1
MK/LTC1 = K1

The TL1, B12 and K1 counts per second contain the aircraft associated backgrounds caused by thorium, uranium and ^{40}K. Geodata has determined these backgrounds for the N49504 Lama helicopter, to be 2.53 counts per second in the $^{208}T\ell$ energy interval due to background $^{208}T\ell$, 2.08 counts per second in the ^{214}Bi energy interval due to background ^{214}Bi and 3.67 counts per second in the ^{40}K interval due to background ^{40}K. For this work, the background counting rates were determined by high altitude flights free from atmospheric ^{214}Bi. The backgrounds are checked during the survey by observing counting rates over large water bodies under the flight path.

The backgrounds are subtracted from the above determined count rate values

$$\overline{TL1} = TL1 - 2.53$$

$$\overline{BI1} = BI1 - 2.08$$

$$\overline{K1} = K1 - 3.67$$

The $\overline{BI1}$ value contains counts caused by atmospheric ^{214}Bi which must be subtracted before altitude correction is applied. The 2π crystal data are used to determine the magnitude of the count to be subtracted. Since the predominant variable source affecting the 2π crystal is the atmospheric ^{214}Bi, it is possible to utilize most of the spectrum in the BIAIR determination and thereby produce some improvement in the statistical error. The energy range used for the 2π crystal is from 1.05 to 2.79 MeV. Within this range, the aircraft background has been determined as 3.11 counts per second, and the 2π cosmic count greater than 3.0 MeV must be multiplied by 1.897 to determine the cosmic count in the 1.05 to 2.79 MeV range.

The atmospheric ^{214}Bi (BIAIR) associated with the unshielded detector array is determined using the shielded detector by the relation:

$$BIAIR = \frac{G(X) \cdot \left[VA - 1.897\, COS2 - 3.11 - (k_1\overline{TL1} + k_2\overline{BI1} + k_3\overline{K1})\right]}{(1 - k_2 G(X))}$$

where: G(X) is the relationship between the 4π and 2π detector measurement solid angle and the volume change of the detector arrays.

VA is the total count, 2π, ch (91-239), c/s; COS2 is the 2π cosmic count 3.0-6.0 MeV, c/s; k_1, k_2, k_3 are constant correction factors for the penetration/spill of the surface emanated radiation, and are respectively

$\overline{TLI}$, $\overline{BII}$, $\overline{KI}$ are results of data reduction, 4π, c/s

The final ^{214}Bi counting rate caused by surface sources then

$$BISUR = \overline{BII} - BIAIR$$

The quantities $\overline{TLI}$, BISUR and $\overline{KI}$ are then corrected to an equivalent counting rate at 400 feet through the equations indicated below:

$$TLS = \overline{TLI} \cdot e^{-\mu_1(400 - \frac{\rho}{\rho_o} x)}$$

$$BIS = BISUR \cdot e^{-\mu_2(400 - \frac{\rho}{\rho_o} x)}$$

$$KS = \overline{KI} \cdot e^{-\mu_3(400 - \frac{\rho}{\rho_o} x)}$$

where:

TLS, BIS, KS = respective counting rates at 400 feet caused by surface sources

ρ = air density

ρ_o = .001293 gm/cc, air density

μ_1, μ_2, μ_3 = respective linear attenuation coefficients

x = aircraft height above the surface in feet

Following data reduction, average values for each radiation variable and variable ratio are plotted for each flight line to demonstrate the consistency of average values and that a smooth flow of results continues from day to day and from start to finish of each day. Quality control on the eU (BIAIR) in the atmosphere is also monitored through examination of data acquired over water with the requirement being that near-zero intensities for BIS should exist.

Each profile has a latitude or longitude degree line to give accurate surface location of all data.

Magnetic field data are determined at the crossings of the tie line and map line data, and the corrections for the diurnal variations are determined. Any heading errors have previously been removed from all data. The magnetic field data are then IGRF corrected to give the residual magnetic field.

D. DATA PRESENTATION

The surveyed area was positioned geographically to completely cover the specific National Topographic Map. The topographic map has been used as the flight base and sufficient geographical and 15' location information have been shown. The flight line pattern has been superpositioned onto these created base maps where the standard deviation levels for each independent variable and each ratio of these variables have been plotted (NGRMS) based on the data contained within the total map area. Every fifth data point along each map line has its standard deviation value shown at the location of that value. Therefore, there are six NGRMS sheets which indicate the location and magnitude of anomalous data, Volume II.

The radiometric multi-variable map line profile, which represents all variables as a function of their latitude or longitude location, depending on line direction, for each line, is presented at a scale of 1:500,000. Each profile presents:

1. Aircraft altitude above the surface
2. eTh ($^{208}T\ell$ from ^{232}Th decay series)
3. eU (^{214}Bi from ^{238}U decay series)
4. K (^{40}K from natural potassium)
5. BiAir (atmospheric ^{214}Bi)
6. Residual magnetic field
7. Gross count (greater than 400 keV)
8. eU/eTh ($^{214}Bi/^{208}T\ell$) ratio
9. eU/K ($^{214}Bi/^{40}K$) ratio
10. eTh/K ($^{208}T\ell/^{40}K$) ratio
11. Geologic data including aircraft flight path

The magnetic multi-variable map line profile, which represents five variables as a function of their latitude or longitude location, depending on line direction, for each line, plus geologic data at a scale of 1:500,000, is presented as:

1. Aircraft altitude
2. Atmospheric temperature
3. Atmospheric pressure
4. Magnetic field base line station data
5. Residual magnetic field data
6. Geological data including aircraft flight path

The output of these various computations supplies, beyond the two profile sets, the following data:

* Histograms of the radiation data distribution within each geologic unit.

* Histograms of the average velocity distribution for each one-second record for each map and tie line.

* Histograms of the average altitude distribution for each one-second record for each map and tie line.

* Tables giving the average radiation concentration of each geologic unit for each flight line.

* Set of maps showing the standard deviation data as a function of location and radiation variable.

These types of presentation will be explained in this report.

SECTION III.

GEOLOGY OF THE SURVEYED AREA

A. LOCATION AND GENERAL PHYSIOGRAPHY

The airborne radiometric and magnetic survey was conducted over a part of northwestern Utah and a minute portion of southern Idaho. The Brigham City National Topographic Map Sheet area (N.T.M.S., 1954) is bounded by latitudes 41°00' to 42°00' north and longitudes 112°00' to 114°00' west. The area includes all or part of the counties of Box Elder, Cache, Cassia, Davis, Franklin, Oneida, Tooele and Weber.

The area depicted by the Brigham City National Topographic Map Sheet lies mainly in the Basin and Range Physiographic Province; however, the eastern margin of the area is peripheral to the Rocky Mountain Physiographic Province. A number of ranges, generally with north to south orientation, occur. These ranges are from west to east: the Pilot Range, the Goose Creek Mountains, the Grouse Creek Mountains, the Muddy Range, the Silver Island Mountains, the Little Pigeon Mountains, the Raft River Mountains, the Bally Mountains, the Newfoundland Mountains, the Matlin Mountains, the Baker Hills, the Hogup Mountains, the Lakeside Mountains, the Hansel Mountains, the North and South Promontory Mountains, the Blue Spring Hills, the West Hills, and the Wellsville Mountains. Separating the ranges are intermontane valleys and large basins. The most prominent basin is presently occupied by the Great Salt Lake and by the Great Salt Lake Desert. Surficial sediments associated either with past or present inland salt lakes occupy more than fifty percent of the map area. The waters of the Great Salt Lake occupy much of the eastcentral part of the map area. Rivers have their sources in the ranges and, in general, flow toward the Great Salt Lake Basin. Many of the streams are ephemeral, and many dry up prior to reaching the Salt Lake.

B. GEOLOGY

Precambrian Era

The Paleozoic, Mesozoic and Cenozoic rocks of northwestern Utah and adjacent areas are unconformably underlain by granite-gneiss-migmatite complexes of Precambrian age (Condie, 1969). The Precambrian complexes are exposed in the cores of certain mountain ranges within the map area. The two major divisions in the Precambrian basement complexes are the Wyoming and Churchill Precambrian orogenic provinces (Condie, 1969). Major orogeny and granite formation are recorded in the Wyoming Orogenic Province between 2.5 to 2.7 billion years B.P., and in the Churchill Orogenic Province between 1.6 and 1.8 billion years B.P. The corresponding orogenies are known as the Kenoran and Hudsonian orogenies (Condie, 1969).

Approximately eighty percent of the western part of the Wyoming Orogenic Province is composed of granitic rocks and associated gneisses, migmatites and agmatites. Amphibolite and basic igneous rocks comprise another ten percent, and assorted metasedimentaries and metavolcanics most of the remaining ten percent (Condie, 1969). All of the metasedimentary-metavolcanic terrains are engulfed, metamorphosed, and in places, partially granitized by the surrounding granitic rocks (Condie, 1969).

The Churchill Orogenic Province underlies much of the surveyed area. The largest exposures known as the Farmington Canyon Complex occur on Antelope and Carrington islands in the Great Salt Lake (Condie, 1969). The Farmington Canyon Complex is composed mainly of granitic gneisses and migmatites, and lesser amounts of amphibolite and pegmatite. Structural trends in the Farmington Canyon Complex are complex as a result of superimposed Laramide thrusting and folding. The Precambrian trend is predominantly northerly (Condie, 1969).

The Utah-Nevada Province is composed of Late Precambrian strata deposited unconformably on the Churchill and Wyoming complexes. Within the geographic confines of the map area, the Utah-Nevada Province is composed of two subprovinces, the Big Cottonwood and the Uinta subprovinces. The Big Cottonwood Subprovince, which covers most of the older Precambrian terrain in the map area, is characterized by a quartzite-subgraywacke association (Condie, 1969). The basal section of the Big Cottonwood is exposed on Antelope and Carrington islands. The best exposures of the basal contact occur on the northern end of Antelope Island, where a conglomeratic subgraywacke phyllite overlies, unconformably, the Farmington Canyon Complex. The top of the Big Cottonwood sections appear to be conformable with the overlying Mutual Formation of the Uinta Subprovince, or with the Prospect Mountain Quartzite of Cambrian age (Condie, 1969). In the Wasatch Mountains to the east of the map area, an angular unconformity separates the Big Cottonwood Series from the Mutual Formation (Condie, 1969). This unconformity has been interpreted as being the result of significant uplift in the Wasatch area during Late Precambrian and Early Cambrian times. "....This evidence, in turn, suggests that the present-day Wasatch fault system may have developed along a zone in which tectonic activity began by at least 600 m.y. ago...." (Condie, 1969, p. 85).

The Big Cottonwood Series is composed of dominantly white to buff quartzites and siltites, with lesser amounts of subgraywacke, conglomeratic subgraywacke, carbonate rocks and diabase dikes and sills (Condie, 1969, p. 85). The conglomeratic subgraywackes are sometimes described as tillites, and are mapped in the surveyed area with the Mineral Fork Formation (P€mf).

Two sedimentary environments existed in the northeastern Great Basin during the Late Precambrian (Condie, 1969). The first environment is characterized by massive, in places cross-bedded, quartzites. These were deposited in a widespread, shallow sea. Nearshore, or tidal flat, conditions may have existed periodically (Condie, 1969). A second, less extensive, environment is characterized by the subgraywackes and the conglomeratic subgraywackes. Textural and structural evidence in the rocks suggests a turbidity current-subaqueous mud flow origin, rather than glacial tillite origins (Condie, 1969, p. 86).

The Late Precambrian rocks in the Big Cottonwood Subprovince vary from being unmetamorphosed in certain upper sections to amphibolite-facies grade at other locations. Most of the rocks exposed in the subprovince have been metamorphosed to the lower greenschist facies. The amphibolite-facies regional metamorphism was apparently contemporaneous with the Mesozoic-aged thrust-faulting and recumbent folding (Condie, 1969, p. 87).

Paleozoic Era

The Cambrian System consists of strata deposited in a miogeosynclinal environment along the western border of the Precambrian land mass. There is no evidence of major diastrophism in the map area, and no lava flows are mapped for this period. Erosion lowered the continental area and the Cambrian seas transgressed slowly inward over broad shoals (Stokes, 1969). A classical transgressive series is preserved in many sections. In the map area, the top of the quartzite series is near the Early-Middle Cambrian boundary. The Cambrian System contains a very large volume of sediments and many formations have been named. The Cambrian section thickens westward away from the Wasatch Fault Zone, because of a greater period of deposition and the effects of pre-Mississippian denudation (Stokes, 1969).

Thick Cambrian sections occur in the Lakeside and Promontory mountains; the thickness averages between 7,000 and 8,000 feet, and is divided into a number of formations. Formational names originate from early studies. The Ute, Blacksmith, Bloomington, Nounan and St. Charles were named by C.D. Walcott for the Cache Valley area. The Tintic and Ophir formations were named in the Tintic Mining District. The Prospect Mountain, Marjum and Weeks formations were also based on C.D. Walcotts early work (Stokes, 1969, p. 39). The carbonates occur mainly in the Middle and Upper parts of the Cambrian section, and have become host rocks for a variety of hydrothermal bodies (Stokes, 1969).

The Ordovician System is well-represented in the map area. The depositional basins and source areas were similar to those of the Cambrian (Stokes, 1969), and in many places, no depositional break is observable. Stokes (1969, p. 40) divides the Ordovician strata of northern Utah into three formations: the Garden City Limestone, of Canadian and Early Chazyan times; the Swan Peak and Eureka quartzites, of Late Chazyan and Early Bolarian times; and the Fish Haven Dolomite, of Late Bolarian to Cincinnatian time. "....Typical thicknesses are Garden City, 1,300 to 3,000 feet; Swan Peak, 250 to 500 feet; Fish Haven, 500 to 1,000 feet...." (Stokes, 1969, p. 40). The Garden City Limestone has internal lithologic units, which may eventually be designated as formations; such subdivision may follow the prescribed pattern of the Pogonip Group, an equivalent unit mapped in the Confusion Basin (Stokes, 1969, p. 40).

The Silurian System is represented by one formation, the Laketown Dolomite. The unit averages about 1,200 to 1,500 feet of thickness. The Laketown contains a variety of carbonate rocks, many of which are true dolomites. Chert is present and small vugs lined with clear, quartz crystals (Stokes, 1969). Following the deposition of the Laketown, there is a depositional hiatus before the earliest rocks of the Devonian Period.

Early, Middle and Late Devonian sediments are present in the Salt Lake Region. Thick carbonate deposits accumulated in the miogeosyncline area. A local diastrophism during the Late Devonian was centered in the vicinity of the present-day Stansbury Range and affected local deposition. A north-south anticline developed, and the uplifted Precambrian and Early Paleozoic rocks were eroded to produce coarse clastic units (Stokes, 1969, p. 41). Three competing systems of Devonian nomenclature are used in the mapping of the area. One system, developed in the Gold Hill area includes the Simonson Dolomite, some 600 to 900 feet thick, and the Guilmette Dolomite, some 900 to 1,500 feet thick. The Bear Lake section includes the Jefferson Dolomite, some 1,200 feet thick. The earliest unit is the Water Canyon Formation, which is Early Devonian and some 200 to 500 feet thick. The Water Canyon is generally agreed to be the equivalent of the Sevy Formation of the Gold Hill section (Stokes, 1969).

The section of marine Mississippian deposits is well-preserved and thick. The system is dominated by limestone. The nomenclature, like that of the Devonian, was defined in areas to the north and to the south. The Madison Limestone is the name most commonly applied to the Early Mississippian carbonates (Stokes, 1969). Overlying the Madison is the Deseret Limestone of Osagean age, which is extensively distributed throughout the area. A change from predominantly limestone to mixed clastic-carbonate lithologies occurs in the Humbug Formation of Early Meramec time. The Humbug has a thickness in excess of 1,500 feet in the Lakeside Range. A prolonged period of carbonate deposition reoccurred in Upper Meramec and Lower Chester time when the great thicknesses of the Great Blue Limestone were formed. A final depositional episode in the Mississippian continued into the Early Pennsylvanian. A thin, black shale was laid-down, and is termed the Manning Canyon Formation.

The Pennsylvanian and Permian systems have similar lithologies, and originated in the same general environment (Stokes, 1969, p. 43). The dominant structural feature was the Oquirrh Basin. The axis of the Oquirrh Basin has a northwesterly trend, and conforms with the Hercynian Orogenic Belt (Stokes, 1969, p. 43). The gradual subsidence of the basin and the consequent sedimentation occurred during the Morrowan-Wolfcamp interval (Stokes, 1969). Some 30,000 feet of sediment accumulated, most of which is included in the Oquirrh Formation. The Oquirrh Formation crops-out extensively in the Lakeside and Promontory ranges. The unit consists of approximately cyclical accumulations of limestone, dolomite, sandstone, orthoquartzite, siltstone, and shale.

After the Oquirrh Formation, a more varied series of strata were formed. The Pequop Limestone was deposited in the Pequop-Phosphoria Basin during Leonard time. A regional unconformity separates the Pequop from the overlying Phosphoria Group. Also of Guadalupe time are the Gerster Limestone and Plympton Formation in the southern part of the area, and the Park City Group of the Oquirrh Basin. The Park City was extensively formed in the map area. As is the case with the Phosphoria

Group, it contains minor amounts of phosphate rock. The Park City Group is comprised of: the Grandeur Limestone, the Meade Peak Shale and the Franson Limestone. The Grandeur Limestone and the Meade Peak Shale are mapped separately in places, and have been assigned to the Phosphoria Group in the Pequop-Phosphoria Basin area.

Mesozoic Era

In the Early and Middle Paleozoic, the map area had been predominantly part of a subsiding geosyncline; to the east of the Wasatch Line, there had existed a stable or mildly negative area (Stokes and Heylmun, 1963, p. 19). The influence of the orogenic forces which formed the Ancestral Rocky Mountains in Late Paleozoic time had lessened the divisiveness of the Wasatch Line.

In Early Triassic time, the Early and Middle Paleozoic type of tectonic configuration had been temporarily reasserted. During this time, the only Mesozoic unit that is presently exposed in the map area was laid down. The Thaynes Formation crops-out in the Muddy, Goose Creek and Hogup ranges. The Thaynes Formation is a complex lithological unit which consists of limestone, siltstone and fine sandstone. Regionally, it has westward-tapering, non-marine tongues and eastward-tapering, marine tongues.

In Middle Triassic time, the tectonic configuration was reversed. The belt to the west of the Wasatch Line was elevated; whereas, the area to the east began to subside and received sediments. Stokes and Heylmun, (1969, p. 19) use the term Mesocordilleran Highland for the uplifted area. It is a difficult feature to reconstruct for it was later obscured by the effects of subsidence, erosion and volcanism. However, it was a major source of eroded material during its existence (Stokes and Heylmun, 1969). Erosion predominated throughout the map area. No Middle Triassic or younger Mesozoic rocks are recognized. During the Jurassic time, the Mesocordilleran Highland stood between the interior Jurassic seas and the ancestral Pacific Ocean, which then extended as far east as western Nevada (Stokes, 1969, p. 45). The Mesocordilleran Highland persisted throughout the Cretaceous; in Late Cretaceous time, the paleogeogrphy shows an enlargement of the Mesocordilleran Highland, being both higher and wider.

Cenozoic Era

The Tertiary was a time of great structural unrest and cataclysmic events. The Tertiary started quietly. Lacustrine and fluvial conditions existed over much of the area. The Paleocene-Eocene sediments are highly conglomeratic, and reddish colored. These Paleocene-Eocene terrestial sediments have been referred to as the Wasatch Series. The series rests on a surface of pronounced relief and may be several thousands of feet thick (Stokes, 1969, p. 47). The uppermost unit is known as the Knight Conglomerate. The chief constituents are pebbles, cobbles and boulders of Precambrian quartzite.

The Oligocene to Pliocene aged sediments are exposed in widely separated areas. Information on these sediments is meager. Most of the sediments are included in the Salt Lake Group. Rocks of this designation are found in the Goose Creek District and in Cache Valley. In all locations, the exposures are part of more extensive sedimentary masses preserved and generally buried in graben areas (Stokes, 1969, p. 47). Generally, the Oligocene aged sediments are rich in volcanic ash and tuff; however, fluviatile-lacustrine sediments also occur. The Pliocene sediments include assorted gravels, sand, and silt, and appear to have accumulated under arid or semi-arid climatic conditions in rapidly subsiding basins (Stokes, 1969).

The tectonic events which deformed the area during the Late Mesozoic and Tertiary are divided by Eardley (1969) into Laramide structures and Basin and Range faults. The Laramide structures pre-date the Basin and Range structures, and also pre-date the Middle and Late Tertiary volcanic extrusions. The Laramide structures are broken by the Basin and Range faults. Eardley (1969) delimits the westernmost part of the Cache Uplift, the northwestern section of the Northern Utah Uplift and most of the Newfoundland Uplift as occurring within the map area. Eardley (1969) notes that the Grouse Creek Range and Raft River Mountains constitute a different structural province.

Eardley (1969) associates nearly all the igneous intrusions in western Utah with the Laramide uplifts. "....They appear to be within the uplift areas or in marginal positions...." (Eardley, 1969, p. 66). The intrusions are mainly silicic, and in the map area, have been classified as either granitoid or porphyritic. The Northern Utah and Cache uplifts do not appear to have generated plutons.

Volcanic outpourings in western Utah began during Late Eocene time. The Oligocene and Miocene was a time when volcanic avalanches inundated large parts of western Utah and great thicknesses of ignimbrite piled up. The volcanic activity was also responsible for extensive lava flows, volcanic mud flows and blanket deposits of air-fall and waterlaid tuffs.

In the region to the west of the Wasatch Fault Line, profound subsidence commenced in the Oligocene and intensified through the Miocene and into the Pliocene. Subsidence continued into the Quaternary Period. Stokes and Heylmun (1963, p. 21) point out that this part of the Basin and Range Province is analogous in some ways to a tremendous collapsed caldera. Contemporaneous with the regional subsidence, epeirogenic uplift occurred. This means the region has maintained a relatively high elevation with respect to sea level (Stokes and Heylmun, 1963, p. 21). In some areas, the subsidence was gradual, and was accompanied by moderate amounts of block faulting and downwarping. Elsewhere, the collapsing was rapid, and chaotic structures resulted (Stokes and Heylmun, 1963, p. 24).

The Pleistocene stratigraphy is mainly associated with that of Lake Bonneville and its predecessors. Early and Middle Pleistocene lakes are known to have existed (Stokes, 1969, p. 48). Stratigraphic names have not yet been given to these sediments. For the Late Pleistocene, the Lake Bonneville Group has been established. A variety of lithologic and textural facies are recorded within this group.

C. BRIEF DESCRIPTION OF THE GEOLOGIC UNITS

Quaternary

Qay: Younger Alluvial Deposits

These alluvial deposits are relatively young, occurring chiefly along active streams.

Qao: Older Alluvial Deposits

These are relatively old alluvial deposits, found primarily on terraces above active streams.

Qa,Qas: Alluvial Surfaces

Alluvial surfaces are mostly sloping, well-drained and lacking stones.

Qag: Coluvium and Alluvium

These surfaces tend to be stoney.

Qds: Dunes

Dunes of a siliceous composition are labeled Qds.

Qlcs,Qlc,Qlsa: Lake Bed Sediments

The permanently moist lake bed sediments (Qlcs) are mostly clay, with a very flat surface and a high salt content. Other lake bed sediments are characterized by dry clay or dust (Qlc). These are poorly drained, and too high in salt content to be suitable for agriculture. A permanent salt crust is found on some lake bed sediments (Qlsa).

Qltg,Qlts: Lake Shore Features

The constructional features of lake shores - terraces, spits, and bars - may be formed of either gravelly deposits (Qltg) or sandy deposits (Qlts).

Qms, Qm: Marshland

Marshes are mostly freshwater, although some may be salty or brackish. (Qm and Qms appear to be same unit)

Qlo,Qlcb,Qbi: Underwater Sediments

The sediments underlying the Great Salt Lake include an oolitic bottom (Qlo), clay or mud (Qlcb), and algal bioherms (Qbi).

Qb: Quaternary Basalt

Extrusive rock formations characterize the Quaternary Basalt.

Quaternary-Tertiary

TQu: Tertiary and Quaternary Undivided

These Tertiary and Quaternary deposits and surfaces of uncertain age are generally brownish and conglomeratic.

Tertiary

Tsl,Tu: Salt Lake Formation or Group

This undifferentiated formation includes continental sandstone, shale, marlstone, silt, and pyroclastic rocks. Deposits are generally very light-colored, ranging in age from the Oligocene to the Pliocene.

T2bf: Late Tertiary Basalt and Basaltic Andesite Flows

T2rf: Late Tertiary Rhyolite-Dacite-Quartz Latite Flows

T_2rt: Late Tertiary Rhyolite-Dacite-Quartz Lacite Flows.

T2rp: Late Tertiary Rhyolite-Dacite-Quartz Latite Pyroclastics

T2ri: Late Tertiary Rhyolite-Dacite-Quartz Latite Ignimbrites

Tk: Knight Conglomerate

This Paleocene and Eocene formation is a chiefly gray to red massive conglomerate. It contains minor amounts of sand and silt.

Tig,Tip: Intrusive Rocks

Tertiary intrusive rocks are granitoid (Tig) or porphyritic (Tip).

Mesozoic

Triassic

Trt: Thaynes Group

The Thaynes Formation is composed of calcareous marine shale, siltstone, and sandstone.

Paleozoic

Permian

lPun: Permian Rocks Undivided

lPcr,lPcmp,lPcgr: Phosphoria Formation or Group

The Rex Chert Member (lPcr) of the Phosphoria Formation is primarily a dark chert or cherty mudstone. In the Meade Peak Member (lPcmp) are found very cherty shales, mudstones and siltstones. Phosphate rock is also present. Dolomite, silty dolomite, and chert comprise the Grandeur Member (lPcgr).

lPg: Gerster Formation

This unit is formed primarily of light-colored limestone. There are minor occurrences of sandstone, siltstone and chert.

lPpl: Plympton Formation

In westcentral Utah, the Plympton Formation is mostly dolomite and chert with phosphatic beds. Further north, it is characterized by a yellowish-gray dolomite and very abundant light-colored chert.

lPpc: Park City Formation

Cherty limestone, siliceous shale, phosphorite, and phosphate rock comprise the Park City unit. The formation dates is of Leonardian and Guadalupian age.

lPde: Diamond Creek Sandstone - Diamond Creek Sandstone is a light-colored, cross-bedded |sandstone.

lPp: Pequop Formation

The Pequop Formation is a Leonardian deposit of light-colored limestone, fine-grained sandstone and reddish siltstone. Evaporites occur locally.

lp€i: Unit mistakenly labeled on original map, should be p€i unit of Precambrian age.

Permian and Pennsylvanian

lPPo: Oquirrh Formation or Group

This Lower Permian/Pennsylvanian unit consists of quartzite, limestone, dolomite, sandstone and shale.

lPPu: Permian and Pennsylvanian Formations Undivided

This designation includes many facies and members that have not been individually differentiated.

Pennsylvanian and Mississippian

PMcd: Chainman and Diamond Peak Formations, Undivided

Chert and quartzite conglomerate, siltstone, shale and silty quartzite are the main components of the combined Chainman and Diamond Peak unit.

l|PMmc: PMmc: Manning Canyon Shale

The Manning Canyon Shale is principally a black shale, with minor components consisting of dark limestone, quartzite and grit.

lPMmc is Manning Canyon Shale - appears to be error on original map.

Mississippian

Mb: Brazer Limestone

The thick-bedded gray, fossiliferous limestone of this formation dates to the Upper Mississippian.

Mgb: Great Blue Limestone

The Great Blue Limestone is composed of both pure and cherty limestones; it is light to dark gray in color.

Mh: Humbug Formation

Quartzitic sandstone is the main component of the Humbug unit. There are minor deposits of limestone and dolomite.

Md: Deseret Limestone

This dark gray limestone or dolomite formation contains abundant chert.

Mm: Madison Limestone

The Madison Limestone is a massive fossiliferous limestone and dolomite formation with minor deposits of chert.

Mc: Chainman Shale

This is a very dark gray to black shale with fetid carbonate beds and sandstone lenses. (Where the Chainman Shale is not differentiated from the Diamond Peak Formation, the map designation is PMcd.)

Ml,Mlp: Lodgepole Limestone and Equivalents

These Lower Mississippian units consist of a thin to medium-bedded limestone that is characteristically cherty and fossiliferous.

Mun: Undifferentiated Mississippian Rocks

The Humbug Formation and Deseret Limestone, undivided, are subsumed by this designation.

<u>Devonian</u>

Dj: Jefferson Dolomite

The Jefferson Dolomite may be light or dark dolomite with shale and sandstone occurring near the base of the formation. The unit is of Middle and Upper Devonian age.

Dg: Guilmette Formation

This is mainly a limestone, but also contains dolomite, sandstone and argillaceous carbonates. The unit was laid down in the Middle and Upper Devonian times.

Dsi: Simonson Dolomite

The dolomite of the Simonson Formation alternates from light to dark gray and from a fine to a coarse-grained texture. It was formed in the Middle Devonian.

Dwc: Water Canyon Dolomite

A Lower Devonian Formation consisting of a dense, splintery dolomite that is very light gray in color.

Du: Devonian Formations Undivided

Silurian

Sl: Laketown Dolomite

The massive, medium-grained dolomite of the Laketown beds ranges in color from light to dark. Most of the formation is of Middle Silurian age, although some locations in central Utah are younger.

Silurian-Ordovician

OS: Silurian and Ordovician Undivided

Undifferentiated dolomite that may pertain to the Laketown or Fish Haven units is mapped as OS.

Ordovician

Ofh: Fish Haven Dolomite

The Fish Haven Formation is composed of a relatively pure, well-bedded dolomite that is medium-gray to dark-gray in color. The unit is of Upper Ordovician age.

Osp: Swan Peak Quartzite

The Middle Ordovician quartzite of the Swan Peak unit is relatively pure and unfossiliferous. It is light yellow to gray in color.

Oe: Eureka Formation

A light-colored, vitreous quartzite and hard sandstone comprise the Eureka unit. The formation was laid down in the Middle Ordovician.

Ogc: Garden City Limestone

The Garden City Limestone is light colored, silty and locally cherty. There is an abundance of intraformational conglomerate. The unit dates to the Lower and Middle Ordovician.

Op,Opu,Opl: Pogonip Group

This unit is composed of limestone, silty limestone, olive shale and intraformational conglomerate. It represents a grouping of (i) the Upper Pogonip, which is mostly Middle Ordovician, and includes the Wahwah, Juab, Ranosh, and Lehman formations; (ii) the Lower Pogonip, which is Lower Ordovician, and includes the House and Fillmore formations. Elsewhere, the Upper Pogonip (Opu) and Lower Pogonip (Opl) are mapped separately.

Ou: Ordovician Undivided

This designation refers chiefly to limestone of the Opohonga Formation, although other undifferentiated formations may also be so designated.

<u>Cambrian</u>

Ꞓsc: St. Charles Formation

This unit is a dark limestone and dolomite deposit with Worm Creek Sandstone at its base.

Ꞓn: Nounan Formation

The Nounan Formation is composed of gray limestone and dolomite.

Ꞓwk: Weeks Formation

The main components of the Weeks Formation consist of light and dark, mainly laminated limestone and dolomite.

Ꞓuu: Upper Cambrian Undivided

This designation refers chiefly to limestone and dolomite deposits found in westcentral Utah.

Ꞓb: Bloomington Formation

Interbedded limestone and argillaceous shale comprise the Bloomington unit. The formation is of Middle Cambrian age.

Ꞓbl: Blacksmith Formation

The Blacksmith Formation is chiefly thick-bedded gray dolomite. Some limestone occurs.

Ꞓu: Ute Formation

Silty limestone and greenish shale are the major components of the Ute Formation.

Ꞓo: Ophir Shale or Group

The Ophir unit is composed of olive-green, micaceous shale and dark limestone.

Ꞓmj: Marjum Formation

Primarily consisting of dark gray limestone and shaly limestone, the Marjum Formation has some local dolomitic components.

Ꞓmu: Middle Cambrian Undivided

Undifferentiated units include the Maxfield and related limestones.

Ꞓpm: Prospect Mountain Quartzite

The Lower Cambrian Prospect Mountain unit is comprised of white to brownish-red quartzite and minor phyllite.

Ꞓt: Tintic Quartzite

The Tintic Quartzite is relatively pure, occurring in white, pink, and yellow varieties. The unit also contains sandstone and minor conglomerate.

Ꞓun: Cambrian Undivided

Map units designated by this label are chiefly limestone.

Pal: Paleozoic Undivided

These units contain rocks of uncertain Paleozoic age.

<u>Precambrian</u>

pꞒm: Mutual Formation

The Mutual unit is chiefly quartzite with a distinctive purple color.

pꞒmf: Mineral Fork Formation

This Upper Precambrian formation is chiefly metamorphosed sediments, including boulder clay (tillite).

pꞒbc: Big Cottonwood

This series is composed primarily of light-colored quartzite and argillite.

pꞒdc: Dove Creek Formation

Quartzite, schist and limestone comprise the Dove Creek unit.

pꞒh: Harrison Formation

The main components of the Harrison Formation are quartzite, schist, and dolomite.

pЄf: Farmington Canyon Complex

The Farmington Canyon unit consists of schist, gneiss, and pegmatites.

pЄi: Precambrian Intrusive Rocks

These undifferentiated rocks are chiefly granitic, with some local metamorphic rocks.

D. RADIOACTIVE MINERAL OCCURRENCES

The Brigham City National Topographic Map Sheet area does not appear to have any well developed, high-grade uranium ore concentrations (Dasch, 1967). However, certain units of the Phosphoria Formation, which outcrops at several locations in the western half of the map area, are uraniferous (Dasch, 1967).

Immediately east of the map area, the Jim Dandy mine is located in the Wasatch Mountains. The ore is uraninite, and is disseminated in biotite-rich zones of pegmatite dikes, that intrude gneiss and schist of the Farmington Canyon Complex, of Precambrian age (Dasch, 1967). Dasch (1967) estimates total tonnage of ore mined for the period 1949-1962 to be between 1,000 and 10,000 tons.

SECTION IV

RESULTS OF DATA ANALYSIS

A. GEOLOGIC BASE MAPS

The Brigham City geologic base map is created to the scale of the NTMS with geologic data and includes latitude, longitude and major geological features. The geologic base map is shown without the superpositioned flight lines at the scale of 1:250,000 and 1:500,000.

* References to Ꞓ in geology appear as E in all computer representations of this character.

B. NATIONAL GAMMA RAY MAP SERIES (NGRMS)

The geologic base has been photographically screened to allow emphasizing of the flight line locations and information regarding data analyses. These maps are the base to which the statistical information for six variables has been added for every fifth data point and are identified as the National Gamma Ray Map Series which are presented at the scale of 1:250,000 and 1:500,000. The detail data for each of these map lines are presented as profile information for six variables. The location of geologic information with statistical data is included along each map line as discussed in Section IV (F).

C. RADIOMETRIC STACKED PROFILES

The profiles of Map Lines 1 - 18 and Tie Lines 1 - 9 are presented within this report at the scale of 1:500,000. The same vertical scale is used for a given variable for all map lines, but the vertical scale changes to fit the specific variable plotted. The scale used for each variable are:

1. Altitude

   100 feet/division, aircraft altitude above the surface; no averaging.

2. $T\ell$ $(^{208}T\ell)$

   10 counts/second/division (C/S/div.). Seven seconds of data are averaged with weighting of 1:2:3:4:3:2:1 and the average value plotted at the center of the group of 7. 5.5 c/s = 1 ppm eTh.

3. Bi (^{214}Bi)

   5 C/S/div; 7-second weighted average as for $T\ell$. 8.0 c/s = 1 ppm eU.

4. K (^{40}K)

30 C/S/div; 7-second weighted average as for Tℓ.
79.5 c/s = 1%K.

5. BiAir

5 C/S/div; 50-second average.

6. Residual Magnetic Field (RMAG)

20 gammas/division; the residual magnetic field is the total magnetic field as measured by a proton precession magnetometer from which has been subtracted the International Geomagnetic Reference Field (Stassinapoulous; NSSDC-72-12).

7. Total Count, 400 keV to 2.80 MeV (GC)

250 C/S/div; no averaging

8. ^{214}Bi/^{208}Tℓ Ratio (Bi/Tℓ)

.10 /div; 7-second weighted averaging as for Tℓ.

9. ^{214}Bi/^{40}K Ratio (Bi/K)

.05 /div; 7-second weighted averaging as for Tℓ.

10. ^{208}Tℓ/^{40}K Ratio (Tℓ/K)

.10 /div; 7-second weighted averaging as for Tℓ.

11. Geology

The surface geology along the flight line, with a width of about six miles, is displayed above the profiles and the flight path is superimposed.

D. MAGNETIC STACKED PROFILE DATA

For each Map Line and Tie Line, a magnetic multiple-parameter stacked profile is produced at a scale of 1:500,000 in Volume II of this report, and at a scale of 1:250,000 as separate sheets. The same vertical scale is used for a given variable for all Map Lines, but the vertical scale varies to fit the specific variable plotted. The scales used for each variable are:

1. Altitude

100 feet/division; aircraft altitude above the surface; no averaging.

2. Temperature

1 degree celsius/division; no averaging.

3. Barometric Pressure

0.25 inches mercury/division; no averaging.

4. Base Station - Magnetic Field

5 gammas/div; no averaging

5. Residual Magnetic Field

10 gammas/division; no averaging.

E. MAGNETIC TAPES AND LISTINGS

The description of the magnetic tapes and their listings is presented in Appendix II.

F. STATISTICAL AND GEOLOGICALLY-CREATED DEVIATIONS IN RESULTANT DATA

A set of tables are included which list the average value for each geologic unit encountered on each flight line as a function of flight line for each of the radiation variables. See Tables 1-6.

Standard deviations of the data have been calculated assuming the data to have a normal distribution within the geologic type. When geochemical anomalies modify the normal distribution, then the frequency distribution of the data will be distorted about the mean. Geologic unit data have been analyzed to determine the variance.

$$\sigma^2 = \frac{1}{N-1}\left\{\sum_{i=1}^{N} x_i^2 - N\overline{x}^2\right\}$$

where the standard deviation is σ, N is the number of samples, x_i is the value at the sample number i, and $\overline{x}$ is the mean value for the geologic type. The listing for averaged record data output gives the mean value and magnitude of deviations, relative to the mean, with the $\pm 1\sigma$, $\pm 2\sigma$, and $\pm 3\sigma$ levels being placed on the NGRMS Sheets for the six variables as previously explained. The distribution of data within the geologic units encountered are included as histograms in Appendix I.

A statistical adequacy test is run on all data. If the test fails, the value of the displayed ratio variable is set to zero and not included in summary tables which gives the average value. The test is made on $T\ell$(eTh), Bi (eU) and K where:

	DG	DJ	DSI	DWC	GR	GMI	GMJ	GMU	GN	GPM	GSC	EUN	IPCGR	IPCMP	IPCR	IPDC	IPEI	IPG
ML 1			18															
ML 2										37								
ML 3												39						
ML 4						34		46		32								
ML 5							26				25		35		24	35		
ML 6													28	27	26	26		28
ML 7	34														34	25		
ML 8	53																	
ML 9	40			18														
ML10		14		15														
ML11		1																
ML12																		
ML13															30			
ML14														44	26			
ML15															30		69	
ML16											53				76		54	
ML17									24								69	
ML18		21		15	25				62									
TL 1															47			
TL 2	34																	
TL 3																		30
TL 4																		
TL 5																		
TL 6																		
TL 7							34	34	30	32								
TL 8		30																
TL 9																		

Table 1. Geologic Unit Average Value as a Function of Map Line for ^{208}Tl (COUNTS/SECONDS)

	IPMMC	IPPL	IPPO	IPPU	IPUN	MB	MC	MGB	MH	MLP	MUN	OE	OFH	OGC	OSP	PAL	PGBC	PGDC	PGH
ML 1			26									17	10						
ML 2			22		17			19				20	16	14					
ML 3			25					19						53					
ML 4			31		40														
ML 5			35		36			22								15			
ML 6			32	29			24												
ML 7			28	26	22		32				12		16		27			45	
ML 8			28		26														
ML 9			30				28	20	34					1	11			34	
ML10			35			13	44			18				20					
ML11			31			20		24		11									87
ML12			30																118
ML13	35		31															69	111
ML14		70	35		37													73	64
ML15			33		38													57	49
ML16			39		35													77	78
ML17			35											23		20		78	61
ML18			37				54									30		43	49
TL 1																			
TL 2			36	24			47											72	73
TL 3			38																78
TL 4			42		28														50
TL 5			27																
TL 6			33																
TL 7			31					21								1	83		
TL 8			32							23									
TL 9			30																

	PEI	PGM	PGMF	PMCD	PMMC	QA	QAG	QAS	QAY	QBI	QDS	QLC	QLCB	QLCS	QLSA	QLTG	QLTS	QM
ML 1		27					30			17	25	33	19	24		47		22
ML 2							24	26				28	12	24	16	39	25	26
ML 3							38	28			28	38	20	32		34	42	28
ML 4		32		23			29	35	34	17	33	41	10	34		29	42	31
ML 5							37	80	63			54	23	32		28	69	
ML 6			49				36	59	60	10	66	46	18	32		34		32
ML 7							31	27	47			46	16	45		23		39
ML 8					34		54	64	42			48	6	36		30		36
ML 9							48	49	40			41		31		31		31
ML10							38	46	45			43	9	26		66		18
ML11	105				25		38	49	49			44	20	34		61		21
ML12	141				29		44	50	43			53		39		60		28
ML13							39	43	47			49		42		30		
ML14							40	47	49			49				36	65	
ML15						40	56	49	52			54				37	58	
ML16					55	65	40	49	39							29	72	
ML17	46					51	42	48	32							37	68	
ML18	58					52	44	53	44					57		35	54	
TL 1							37	72	60			49		22	17	52	53	
TL 2	112						51	64										
TL 3							69	73				43		26				
TL 4							40	44				44						
TL 5							47	50		10		34		23		29		
TL 6							27	42				34	9	31		37		18
TL 7		32	61		44		55	57				22	9			46		
TL 8								32	28					38		30		39
TL 9							26	34	40				20	49			44	28

	QMS	SL	T2BF	T2RF	T2RP	T2RT	TIG	TK	TQU	TRT	TSL
ML 1		12					95				
ML 2		13									
ML 3							90				
ML 4											34
ML 5											
ML 6			30	84					29	25	
ML 7			41	133		96	54		26		107
ML 8			32	108		87	70		39	24	48
ML 9	25		34	132					42		51
ML10		17	41	111					42		58
ML11				86							52
ML12			39					27			45
ML13			41								47
ML14			40	69					41	37	55
ML15			33	131	103				51	35	42
ML16			46	88							52
ML17			49								90
ML18		27	37	86							75
TL 1				80							73
TL 2							57				
TL 3											36
TL 4			46								42
TL 5				55	79				5		
TL 6			39								
TL 7			44								54
TL 8											
TL 9											44

	DG	DJ	DSI	DWC	GB	GMI	GMJ	GMU	GN	GPM	GSC	GUN	IPCGR	IPCMP	IPCR	IPDC	IPEI	IPG
ML 1			14															
ML 2										12								
ML 3												14						
ML 4						16		17		15								
ML 5							15				44		19		17	23		
ML 6													26	32	18	14		17
ML 7	20														18	13		
ML 8	33																	
ML 9	18			17														
ML10		10		9														
ML11		1																
ML12																		
ML13															21			
ML14														17	16			
ML15															17		19	
ML16											17				31		25	
ML17									13								24	
ML18		11		12	18				23									
TL 1															19			
TL 2	16																	
TL 3																		17
TL 4																		
TL 5																		
TL 6																		
TL 7							14	17	12	15								
TL 8		16																
TL 9																		

Table 2. Geologic Unit Average Value as a Function of Map Line for ^{214}Bi (COUNTS/SECONDS)

	IPMMC	IPPL	IPPO	IPPU	IPUN	MB	MC	MGB	MH	MLP	MUN	OE	OFH	OGC	OSP	PAL	PGBC	PGDC	PGH
ML 1			16									12	5						
ML 2			13		13			14				14	11	12					
ML 3			17					15						18					
ML 4			15		24														
ML 5			18		20			16								8			
ML 6			15	16			13												
ML 7			15	16	12		17				8		10		13			34	
ML 8			17		20														
ML 9			17				16	19	19					1	18			12	
ML10			16			8	21			13				16					
ML11			15			16		16		12									29
ML12			15																29
ML13	15		15															22	26
ML14		21	15		23													21	16
ML15			15		19													19	18
ML16			16		19													25	30
ML17			15											8		11		24	23
ML18			16				17									13		13	20
TL 1																			
TL 2			21	21			28											23	27
TL 3			16																30
TL 4			18		15														21
TL 5			16																
TL 6			14																
TL 7			16					13								1	25		
TL 8			16							22									
TL 9			14																

	PEI	PGM	PGMF	PMCD	PMMC	QA	QAG	QAS	QAY	QBI	QDS	QLC	QLCB	QLCS	QLSA	QLTG	QLTS	QM
ML 1		11					15			10	17	19	15	16		26		14
ML 2							13	14				16	9	15	9	17	12	15
ML 3							21	12			17	17	13	18		16	16	13
ML 4		23		13			14	16	13	7	24	20	10	18		14	14	15
ML 5							19	28	26			25	13	19		16	25	
ML 6			21				19	24	23	8	26	23	15	23		17		50
ML 7							19	12	31			23	15	24		16		34
ML 8					19		24	25	45			22	9	21		17		30
ML 9							21	21	23			19		18		18		173
ML10							18	19	21			20	11	15		36		13
ML11	36				13		19	18	22			20	13	17		24		15
ML12	34				13		20	19	17			22		18		29		14
ML13							19	18	19			21		20		16		
ML14							20	19	19			21				16	26	
ML15						13	19	18	19			23				16	25	
ML16					23	20	16	19	15							12	27	
ML17	19					18	17	18	13							16	21	
ML18	21					21	18	19	16					23		15	18	
TL 1							17	27	25			21		12	10	16	19	
TL 2	27						24	20										
TL 3							27	25				20		15				
TL 4							20	19				22						
TL 5							19	22		11		19		15		17		
TL 6							16	18				21	9	18		17		12
TL 7		11	23		22		13	22				13	3			20		
TL 8								16	14					24		15		23
TL 9							16	16	18				18	22			18	82

	QMS	SL	T2BF	T2RF	T2RP	T2RT	TIG	TK	TQU	TRT	TSL
ML 1		10					34				
ML 2		11									
ML 3							28				
ML 4											15
ML 5											
ML 6			19	33					15	19	
ML 7			20	55		34	30		15		39
ML 8			14	35		29	30		17	14	22
ML 9	12		12	51					21		19
ML10		12	19	44					18		21
ML11				33							20
ML12			14					10			18
ML13			18								19
ML14			15	23					18	19	27
ML15			14	47	40				23	16	19
ML16			15	31							20
ML17			18								32
ML18		11	15	29							27
TL 1				27							27
TL 2							32				
TL 3											18
TL 4			20								16
TL 5				24	33				6		
TL 6			20								
TL 7			19								22
TL 8											
TL 9											20

	DG	DJ	DSI	DWC	6B	6MI	6MJ	6MU	6N	6PM	6SC	6UN	IPCGR	IPCMP	IPCR	IPDC	IPEI	IPG
ML 1			53															
ML 2										112								
ML 3												116						
ML 4						78		110		85								
ML 5							81				69		96		67	117		
ML 6													80	95	69	90		80
ML 7	114														96	119		
ML 8	147																	
ML 9	130			61														
ML10		62		49														
ML11		1																
ML12																		
ML13															73			
ML14														105	71			
ML15															73		125	
ML16											118				158		137	
ML17									97								139	
ML18		53		54	78				137									
TL 1															111			
TL 2	105																	
TL 3																		101
TL 4																		
TL 5																		
TL 6																		
TL 7							102	95	106	101								
TL 8		90																
TL 9																		

Table 3. Geologic Unit Average Value as a Function of Map Line for ^{40}K (COUNTS/SECONDS)

	IPMMC	IPPL	IPPO	IPPU	IPUN	MB	MC	MGB	MH	MLP	MUN	OE	OFH	OGC	OSP	PAL	PGBC	PGDC	PGH
ML 1			93									56	28						
ML 2			62		77			53				68	54	40					
ML 3			80					59						144					
ML 4			94		118														
ML 5			110		99			70								49			
ML 6			118	116			101												
ML 7			75	107	117		121				29		43		93			169	
ML 8			70		87														
ML 9			87				102	75	108					1	55			88	
ML10			101			48	129			51				73					
ML11			92			78		63		35									188
ML12			94																216
ML13	71		112															141	184
ML14		158	116		75													141	123
ML15			111		91													136	106
ML16			113		85													158	148
ML17			105											88		64		149	173
ML18			107				172									93		77	118
TL 1																			
TL 2			111	103			173											142	179
TL 3			129																201
TL 4			129		76														124
TL 5			97																
TL 6			99																
TL 7			95					69								1	136		
TL 8			101							87									
TL 9			110																

	PEI	PGM	PGMF	PMCD	PMMC	QA	QAG	QAS	QAY	QBI	QDS	QLC	QLCB	QLCS	QLSA	QLTG	QLTS	QM
ML 1		81					90			37	81	95	59	78		157		74
ML 2							78	80				85	37	73	60	109	70	70
ML 3							127	81			89	109	56	94		98	135	79
ML 4		91		75			90	94	84	69	101	115	60	100		74	114	91
ML 5							106	175	169			144	69	95		95	151	
ML 6			132				103	143	143	38	155	129	66	95		104		91
ML 7							107	84	125			127	69	138		86		115
ML 8					60		153	149	113			138	23	110		95		107
ML 9							121	121	111			115		90		98		87
ML10							104	130	122			126	34	87		197		56
ML11	232				67		114	133	122			117	76	101		133		63
ML12	233				105		125	133	110			145		123		229		87
ML13							124	122	117			139		134		113		
ML14							127	124	128			141				109	149	
ML15						91	119	129	130			139				115	135	
ML16					99	138	105	136	106							91	139	
ML17	132					115	103	133	103							107	162	
ML18	102					127	114	131	121					138		108	132	
TL 1							112	165	145			142		82	65	172	143	
TL 2	177						156	132										
TL 3							175	156				108		83				
TL 4							111	123				122						
TL 5							137	151		39		108		68		101		
TL 6							89	127				117	41	100		119		59
TL 7		82	146		76		105	135				68	22			122		
TL 8								115	82					117		118		111
TL 9							96	96	110				52	113			115	82

	QMS	SL	T2BF	T2RF	T2RP	T2RT	TIG	TK	TOU	TRT	TSL
ML 1		42					161				
ML 2		38									
ML 3							179				
ML 4											98
ML 5											
ML 6			94	172					92	72	
ML 7			130	242		208	200		80		226
ML 8			109	218		203	196		100	68	109
ML 9	72		100	207					131		114
ML10		66	118	232					103		126
ML11				170							116
ML12			105					82			107
ML13			116								106
ML14			115	135					123	101	129
ML15			99	218	189				125	102	112
ML16			118	163							124
ML17			129								178
ML18		74	123	177							159
TL 1				157							157
TL 2							192				
TL 3											94
TL 4			130								138
TL 5				137	168				26		
TL 6			122								
TL 7			112								138
TL 8											
TL 9											99

	DG	DJ	DSI	DWC	GB	GMI	GMJ	GMU	GN	GPM	GSC	GUN	IPCGR	IPCMP	IPCR	IPDC	IPEI	IPG
ML 1			84															
ML 2										32								
ML 3												39						
ML 4						46		38		49								
ML 5							61				175		56		70	64		
ML 6													96	119	70	56		67
ML 7	59														55	54		
ML 8	58																	
ML 9	45			99														
ML10		72		60														
ML11		1																
ML12																		
ML13															73			
ML14														39	64			
ML15															60		28	
ML16											32				41		50	
ML17									57								36	
ML18		55		77	72				40									
TL 1															41			
TL 2	50																	
TL 3																		56
TL 4																		
TL 5																		
TL 6																		
TL 7							42	51	42	47								
TL 8		57																
TL 9																		

Table 4. Geologic Unit Average Value as a Function of Map Line for $^{214}Bi/^{208}T\ell$ (TIMES 100)

	IPMMC	IPPL	IPPO	IPPU	IPUN	MB	MC	MGB	MH	MLP	MUN	OE	OFH	OGC	OSP	PAL	PGBC	PGDC	PGH
ML 1			63									77	53						
ML 2			60		75			76				69	74	86					
ML 3			72					78						36					
ML 4			51		65														
ML 5			54		56			82								56			
ML 6			47	57			55												
ML 7			56	62	58		54				73		70		51			77	
ML 8			68		75														
ML 9			62				55	92	56					1	159			34	
ML10			48			61	49			75				80					
ML11			52			76		70		109									34
ML12			51																26
ML13	44		50															33	25
ML14		30	45		64													29	25
ML15			47		50													34	37
ML16			43		55													33	40
ML17			44											38		58		30	38
ML18			46				32									46		31	41
TL 1																			
TL 2			57	92			61											36	39
TL 3			45																39
TL 4			45		54														43
TL 5			63																
TL 6			42																
TL 7			55					66								1	30		
TL 8			56							92									
TL 9			47																

	PEL	PGM	PGMF	PMCD	PMMC	QA	QAG	QAS	QAY	QBI	QDS	QLC	QLCB	QLCS	QLSA	QLTG	QLTS	QM
ML 1		40					57			67	68	60	87	69		110		66
ML 2							62	53				60	73	71	63	46	48	57
ML 3							56	46			63	64	64	61		49	43	48
ML 4		72		55			51	46	40	39	74	50	106	58		51	35	50
ML 5							57	37	41			47	62	63		58	38	
ML 6			43				58	41	38	89	39	57	92	77		57		172
ML 7							63	47	74			52	101	54		70		93
ML 8					62		48	43	196			47	154	64		59		107
ML 9							47	49	61			48		67		63		608
ML10							48	44	50			48	130	65		55		73
ML11	35				53		52	40	47			47	68	50		42		84
ML12	24				46		47	40	40			43		48		99		54
ML13							49	43	42			45		49		55		
ML14							49	42	40			43				47	40	
ML15						34	36	39	37			43				44	43	
ML16					43	32	43	40	38							41	38	
ML17	41					37	43	40	40							46	31	
ML18	37					40	45	38	36					41		43	34	
TL 1							47	38	41			44		58	62	32	38	
TL 2	28						48	35										
TL 3							38	34				50		62				
TL 4							52	44				53						
TL 5							40	44		130		71		81		61		
TL 6							59	45				62	104	69		48		76
TL 7		34	37		53		26	40				62	32			44		
TL 8								51	53					65		52		59
TL 9							65	50	48				90	67			43	321

	QMS	SL	T2BF	T2RF	T2RP	T2RT	TIG	TK	TQU	TRT	TSL
ML 1		82					37				
ML 2		88									
ML 3							31				
ML 4											47
ML 5											
ML 6			63	39					55	77	
ML 7			48	41		35	57		59		37
ML 8			46	32		33	43		47	59	47
ML 9	51		37	38					50		39
ML10		70	48	39					44		38
ML11				38							42
ML12			37					38			43
ML13			44								43
ML14			37	33					43	52	57
ML15			43	36	39				48	46	48
ML16			33	37							40
ML17			37								36
ML18		46	42	35							37
TL 1				34							40
TL 2							55				
TL 3											51
TL 4			44								41
TL 5				43	41				121		
TL 6			51								
TL 7			43								42
TL 8											
TL 9											47

	DG	DJ	DSI	DWC	GB	GMI	GMJ	GMU	GN	GPM	GSC	GUN	IPCGR	IPCMP	IPCR	IPDC	IPEI	IPG
ML 1			289															
ML 2										107								
ML 3												128						
ML 4						207		161		198								
ML 5							204				652		203		259	195		
ML 6													330	348	275	160		227
ML 7	182														197	114		
ML 8	207																	
ML 9	142			296														
ML10		165		190														
ML11		1																
ML12																		
ML13															297			
ML14														161	242			
ML15															248		157	
ML16											146				203		192	
ML17									136								179	
ML18		229		223	231				178									
TL 1															174			
TL 2	161																	
TL 3																		169
TL 4																		
TL 5																		
TL 6																		
TL 7							142	183	121	151								
TL 8		190																
TL 9																		

Table 5. Geologic Unit Average Value as a Function of Map Line $^{214}Bi/^{40}K$ (TIMES 1000)

	IPMMC	IPPL	IPPO	IPPU	IPUN	MB	MC	MGB	MH	MLP	MUN	OE	OFH	OGC	OSP	PAL	PGBC	PGDC	PGH
ML 1			177									303	210						
ML 2			213		173			279				212	220	312					
ML 3			225					254						142					
ML 4			170		226														
ML 5			174		202			279								170			
ML 6			131	144			132												
ML 7			213	154	110		145				315		260		147			206	
ML 8			266		231														
ML 9			226				155	256	186					1	333			137	
ML10			170			172	167			260				218					
ML11			179			201		277		345									
ML12			163																158
ML13	220		142																135
ML14		137	135		323													169	149
ML15			141		212													151	135
ML16			147		231													147	172
ML17			147											104		176		162	136
ML18			161				101									154		177	179
TL 1																			
TL 2			189	217			166											168	167
TL 3			138																165
TL 4			145		212														179
TL 5			171																
TL 6			143																
TL 7			187					232								1	187		
TL 8			190							247									
TL 9			129																

	PEI	PGM	PGMF	PMCD	PMMC	QA	QAG	QAS	QAY	QBI	QDS	QLC	QLCB	QLCS	QLSA	QLTG	QLTS	QM
ML 1		144					182			302	218	204	290	222		339		201
ML 2							190	176				206	259	236	167	165	176	230
ML 3							173	161			202	202	235	202		173	148	177
ML 4		255		183			164	173	165	100	243	179	278	200		216	130	172
ML 5							193	168	155			178	198	224		173	161	
ML 6			166				193	170	161	257	167	192	235	263		168		599
ML 7							194	156	278			190	235	175		188		318
ML 8					331		169	181	721			164	415	212		181		348
ML 9							180	190	213			176		222		207		2307
ML10							176	157	180			166	323	200		380		241
ML11	158				204		176	145	184			175	173	172		187		280
ML12	149				125		166	149	156			154		153		262		178
ML13							159	152	168			158		155		146		
ML14							157	156	155			153				154	175	
ML15						145	164	149	150			167				140	196	
ML16					245	151	155	145	140							135	197	
ML17	145					159	168	142	131							158	133	
ML18	206					167	169	152	134					168		141	137	
TL 1							164	165	173			151		154	164	94	139	
TL 2	180						159	157										
TL 3							166	164				195		194				
TL 4							184	158				190						
TL 5							141	149		320		234		265		175		
TL 6							182	148				181	261	216		149		253
TL 7		141	159		311		128	165				203	130			168		
TL 8								140	186					215		133		209
TL 9							176	176	174				358	314			163	1133

	GMS	SL	T2BF	T2RF	T2RP	T2RT	TIG	TK	TQU	TRT	TSL
ML 1		244					215				
ML 2		306									
ML 3							159				
ML 4											161
ML 5											
ML 6			203	191					172	274	
ML 7			154	230		164	154		195		175
ML 8			135	159		143	157		182	214	204
ML 9	188		129	242					165		176
ML10		187	169	190					180		174
ML11				196							182
ML12			138					128			182
ML13			159								194
ML14			133	168					146	202	241
ML15			144	219	211				190	156	178
ML16			129	195							163
ML17			142								180
ML18		167	128	166							174
TL 1				172							178
TL 2							165				
TL 3											197
TL 4			159								124
TL 5				177	196				256		
TL 6			164								
TL 7			171								162
TL 8											
TL 9											208

	DG	DJ	DSI	DWC	GB	GMI	GMJ	GMU	GN	GPM	GSC	GUN	IPCGR	IPCMP	IPCR	IPDC	IPEI	IPG
ML 1			347															
ML 2										336								
ML 3												342						
ML 4						447		420		401								
ML 5							333				364		372		372	303		
ML 6													351	291	388	289		350
ML 7	306														357	213		
ML 8	361																	
ML 9	313			306														
ML10		230		320														
ML11		1																
ML12																		
ML13															409			
ML14														411	376			
ML15															422		555	
ML16											448				490		392	
ML17									248								498	
ML18		405		286	328				447									
TL 1															429			
TL 2	326																	
TL 3																		305
TL 4																		
TL 5																		
TL 6																		
TL 7							338	359	288	322								
TL 8		334																
TL 9																		

Table 6. Geologic Unit Average Value as a Function of Map Line $^{208}Tl/^{40}K$ (TIMES 1000)

	IPMMC	IPPL	IPPO	IPPU	IPUN	MB	MC	MGB	MH	MLP	MUN	OE	OFH	OGC	OSP	PAL	PGBC	PGDC	PGH
ML 1			281									390	387						
ML 2			355		233			374				303	298	368					
ML 3			314					337						379					
ML 4			330		342														
ML 5			323		365			330								300			
ML 6			280	253			242												
ML 7			386	248	190		266				435		388		294			265	
ML 8			396		307														
ML 9			359				284	278	326					1	206			398	
ML10			355			284	344			350				290					
ML11			353			277		392		325									468
ML12			323																531
ML13	496		286															518	593
ML14		445	304		504													514	524
ML15			304		426													423	459
ML16			349		422													489	528
ML17			338											270		318		526	362
ML18			348				316									331		566	440
TL 1																			
TL 2			330	237			273											497	441
TL 3			306																418
TL 4			335		388														420
TL 5			276																
TL 6			337																
TL 7			345					336								1	611		
TL 8			333							276									
TL 9			274																

	PEI	PGM	PGMF	PMCD	PMMC	QA	QAG	QAS	QAY	QBI	QDS	QLC	QLCB	QLCS	QLSA	QLTG	QLTS	QM
ML 1		350					341			454	318	342	333	323		607		305
ML 2							312	337				342	372	335	267	362	366	402
ML 3							309	349			320	335	366	337		349	329	365
ML 4		350		336			321	375	410	255	333	358	225	347		412	371	344
ML 5							345	451	376			377	328	352		300	430	
ML 6			388				349	414	423	287	428	350	267	347		308		360
ML 7							303	332	375			364	237	326		275		343
ML 8					551		354	424	369			349	302	334		317		345
ML 9							384	402	356			362		347		326		363
ML10							369	359	364			347	263	306		681		332
ML11	461				387		341	367	396			375	263	343		456		340
ML12	606				274		352	378	393			365		320		527		332
ML13							322	358	401			351		315		264		
ML14							321	381	386			353				330	439	
ML15						435	464	384	398			385				326	449	
ML16					567	471	368	367	368							325	523	
ML17	350					438	396	360	324							348	420	
ML18	551					415	380	405	364					413		326	406	
TL 1							345	435	416			347		274	270	305	368	
TL 2	639						331	467										
TL 3							413	471				397		312				
TL 4							359	355				361						
TL 5							345	337		260		325		337		289		
TL 6							307	327				290	239	314		308		329
TL 7		408	425		591		513	419				330	420			383		
TL 8								280	348					332		258		360
TL 9							273	358	366				403	438			385	349

	QMS	SL	T2BF	T2RF	T2RP	T2RI	T1G	TK	TQU	TRT	TSL
ML 1		298					585				
ML 2		346									
ML 3							505				
ML 4											346
ML 5											
ML 6			321	486					319	352	
ML 7			317	553		461	281		340		475
ML 8			297	491		430	361		387	364	446
ML 9	368		341	628					324		450
ML10		267	348	482					408		471
ML11				511							444
ML12			372					337			427
ML13			354								449
ML14			353	507					339	382	434
ML15			334	600	539				410	343	381
ML16			390	531							419
ML17			380								500
ML18		368	305	486							474
TL 1				500							456
TL 2							299				
TL 3											389
TL 4			355								303
TL 5				405	472				210		
TL 6			318								
TL 7			395								387
TL 8											
TL 9											447

(1) $\sigma_{T\ell} = \sqrt{T\ell_{\Sigma} - \overline{T\ell_1}}$; Test does not fail if $\overline{T\ell_1} \geq 1.5\ \sigma_{T\ell}$

(2) $\sigma_{Bi} = \sqrt{Bi_{\Sigma} - \overline{Bi}_{SUR}}$; Test does not fail if $\overline{Bi_1} \geq 1.5\ \sigma_{Bi}$

(3) $\sigma_{K} = \sqrt{K_{\Sigma} - \overline{K_1}}$; Test does not fail if $\overline{K_1} \geq 1.5\ \sigma_{K}$

Where Σ represents the total raw count in the energy interval, and subscript (1) represents results of 4π data analysis. A column set is placed onto the microfiche for the single point listings of reduced data which lists A-K-U-T as altitude (A), potassium (K), uranium (U) and thorium (T). If the statistical adequacy test does not fail, a zero (0) is inserted. If it fails, a one (1) is inserted for the K-U-T. However, for altitude (A), 0 represents data from 0-700 feet. 1 represents data from 701-1000 feet, and 2 represents data from 1001 and greater feet.

G. FREQUENCY DISTRIBUTIONS OF DATA FOR EACH GEOLOGIC TYPE

The geologic units have been the basis for separation of the six radiation variables. Frequency distribution plots, which display the number of occurrences at a specific magnitude as a function of the magnitude for each of the six radiation variables, are included for each geologic unit. Data from all map line and tie lines have been included to determine these frequency distributions in Appendix I. Table A1-1 gives a summary of the average and standard deviation values for all geologic units, (also included on all histograms in Appendix I). Data not passing adaquacy tests are not included in the histograms.

H. MICROFICHE REPRODUCTION OF THE SINGLE RECORD REDUCED AND AVERAGED RECORD DATA

The output listings of the single record non-averaged reduced data and averaged record data have been reproduced on MICROFICHE and are included with the report where up to 208 computer listings may be placed on a projectable 4" x 5-3/4" transparency.

I. TEST LINES

Flight lines within the map sheet area were chosen having a length of about five miles, and were surveyed prior to and following each day's operation, conditions allowing such flights. The results of these test line surveys over the same morning and evening surface location are summarized in Appendix III.

J. ALTITUDE AND GROUND SPEED HISTOGRAMS

A histogram of the ground speed of the helicopter and its altitude are included for each map and tie line in Appendix III.

K. ANOMALOUS DATA DETERMINED FROM EXAMINATION OF PROFILE LINE DATA

An evaluation of the results of all data from flight line profiles and statistical deviation maps (NGRMS maps) is made for each line. Particular attention should be given to the eU/eTh ratio in the profile data and in the NGRMS map to detect regions of anomalous eU.

1. <u>Analysis of Histograms</u>

The radioactivity data is shown in histogram form with counts per second (c/s) plotted against number of events (Appendix I). The histograms for $^{208}T\ell$ and ^{40}K were examined for conformity to a Gaussian curve. It is generally assumed that a geologic map unit, which encompasses a fairly homogeneous lithology, would have a unimodal distribution. Where map units vary significantly from a unimodal distribution, a further subdivision into more homogeneous lithologic types may be recommended. Table 7 shows the map units which vary from a unimodal model, and for which separation into two or more distributions is feasible. Only units with over 200 events are considered.

2. <u>Interpretation of Radioactivity Data</u>

<u>Introduction</u>

The $^{208}T\ell$, ^{214}Bi, and $^{214}Bi/^{208}T\ell$ (ratio) data were examined for anomalous values. An anomaly is defined by a minimum of two adjacent, two-standard deviation values, or a single, three-standard deviation value. The anomalies were listed by flight line in Table 8; by geologic map unit in Table 9; Table 9 is statistically summarized in Table 10. Only positive anomalies were examined for $^{208}T\ell$ and ^{214}Bi, but both positive and negative values were studied for the ratio anomaly.

<u>The Relationship of Radioactive Anomalies to Geologic Map Units</u>

Quaternary Units: Qay,Qas,Qa,Qag,Qlc,Qltg,Qlts,Qm,Qlcb,Qlcs, Qlsa,Qbi,Qlo

$^{208}T\ell$ Anomalies

Forty-five percent of the geologic map units which have $^{208}T\ell$ anomalies are Quaternary; the Quaternary units account for approximately sixty percent of the $^{208}T\ell$ anomalies. Most of the anomalies occur in the Qas, Qlc, Qag, Qlcs units. The Qlcs and Qlc units are lacustrine sediments, mostly clays; whereas, the Qas unit is alluvium, without stones. A high percentage of the $^{208}T\ell$ anomalies coincide with ^{214}Bi anomalies. These coincidences are thought to reflect locations where the background radioactivity count is affected either by (i) litho-changes within a unit, or (ii) changes in moisture content of the surficial sediments.

^{214}Bi and $^{214}Bi/^{208}T\ell$ Anomalies

Sixty-two percent of the ^{214}Bi and seventy-seven percent of the positive ratio anomalies occur in the Quaternary units. The ^{214}Bi anomalies are concentrated in the Qas (22), Qag (7), Qlc (10), Qlcs (6) units; whereas, the positive $^{214}Bi/^{208}T\ell$ anomalies are concentrated in the Qas (32), Qag (12), Qlc (11), Qlcs (38) and Qbi (14) units. Most of

TABLE 7. Units with More Than 200 Events Having Distributions Significantly Varying from Unimodality

Geologic Units	No. of Events	Split Recommended
Qay	1,922	50
Qa	701	60
Qag	4,352	no
Qltg	2,120	no
Qlts	1,292	no
Qlcb	622	18
TQu	335	no
Tsl	4,578	no
T2rf	1,157	67;137
lPun	412	no
lPcr	473	no
PMmc	270	no
Mc	238	no
Dg	278	no
P€mf	205	no
P€dc	1,139	no
P€h	1,995	no
P€i	356	no

TABLE 8. Summary of Anomalies

	^{208}Tℓ	^{214}Bi	^{214}Bi/^{208}Tℓ
ML1E			Qag,40,50;
ML1W	Qlc,560;	Tig,440;	Qlcs,1420,1570,2295-2330; lPPo,1740-1745;Qltg,1800;
ML2E			Qlts,680-685;
ML2W			Qlcs,2850-2870;Qlc,2880-2885,2905-2915,3200-3205; Qlcs,3355-3360,3375-3395,3510-3515,3545-3555,3630-3635;Qag,4030-4040;Dsi,4725-4730;
ML3E			
ML3W	Qlcs,190-195,300-320;	Qlcs,310-315;	Qlcs,965,1045,2145-2160; Qlc,2170-2195,2340-2350; lPPo,2330;Qbi,2370;
ML4E			
ML4W	Qlcs,3960-3965,4025-4040 4050-4075,4085-4155;		Qbi,2700,2720-2730;Qlcs,2740-2745,2760;
ML5E	Qas,3750-3775;Qag,3775-3790;Qlts,3795-3815;	Mgb,2880;Ꞓsc,3065-3070; Qas,3750-3775;Qag,3775-3785;pꞒf,3790-3800;	Pal,2775;Mgb,2880-2890; Ꞓsc,3065-3070;Qlcs,3360,3425-3430;
ML5W		lPdc,4850-4855;Qlcs,3720-3725;	Qlc,4655;Qag,4675-4680;
ML6E		Qlcs,240-280,290,320-340;	Qm,235;Qlcs,240-280,1265-1275,1290,1305-1315; Qlc,1100-1115,1225-1255,1405-1410,1485-1490;T2bf,1470;Qbi,1520,1530;
ML6W	Qlc,7340,7355-7375,7405-7415,7430-7435,7450-7455;T2rf,7345-7350;Qltg,7480-7490;	Qlc,7345-7370,7380-7400,7410-7440,7480; Qltg,7520-7530;Qas,7615-7620;	Qlcs,5460-5465;Qltg,5630; Qag,5840-5860;Trt,6135-6140;Qlc,6720-6730;
ML7E	Qm,2865-2890;	Qay,2820;	lPPo,2020-2035;
ML7W	Tsl,4185-4190,4200-4235,4515-4555;Qlc,4250-4285,4305-4325,4340-4360;	Qlc,3685-3695;Tsl,4170-4180,4210-4240,4515-4530,4545-4555;Qlc,4250-4280,4310,4325-4350;	Qbi,2500-2515;pꞒdc,3835-3850;TQu,4120;

(TABLE 8. Cont'd.)

	^{208}Tℓ	^{214}Bi	^{214}Bi/^{208}Tℓ
ML8E		1PPo,2245-2255;Qay, 3165-3200;Qas,3240;	1PPo,2065-2090,2100-2130;Qas,2325;3245;Qay, 3165-3195;
ML8W	Qas,195-200,255-280; TQu,395-400;Dg,560-570; Qag,885-890;Qlc,895-935	T2rf,190-200,230-240;Dg 630-650;Qag,875-885;Qlc 895-900;	[Qag,120-125;] Dg,530-540;Qag,1720-1730;Qltg, 1835;Qlcs,2000-2005;Qbi, 2035;
ML9E	Qlcs,945-950;	Qm,115-185;	Qas,95,1220-1230;Qm, 110-160;Qltg,465-475; 1PPo,1080-1110;
ML9W	Qlc,4940-4945;Qas,5755-5775;Qag,5840-5915,5940 -5950;	Qas,5755-5780,5830;Qag, 5840-5860,5885-5905;	Qlcs,3700-3780,3800;
ML10E	Qas,2095-2100;	Qas,2220-2235;	Qas,2160-2165,2235-2240, 2535;Qag,2970-2975;
ML10C			
ML10W	1PPo,6800-6805;	Tsl,6065-6070;	Qag,6615;Qbi,8125-8130;
ML11E	Qas,320-335;Qltg,350-375,405-435;	Qltg,365,400-420;	Qas,495,525-530,860-870, 1190-1195;Mlp,1260;
ML11W	Qay,7025-7040;pGh,7285-7290;Qas,7505-7525;	pGh,7255-7265,7285-7290;	
ML12E			
ML12W	Qlc,5475-5480,5730-5735; Qas,6090-6105,6110-6115; pGh,6200-6260;	Qas,6105-6115;	[Qas,6095-6100;]
ML13E		Qas,6130-6140;	Qas,5790-5800,5840-5850, 6115-6130;
ML13W	pGh,3060-3085,3100-3115;		Tsl,2690-2695; [pGh,3100-3105;]
ML14E		Qas,3380-3400;	Qas,4575-4595,4910,4985;
ML14W	pGdc,1750-1760;Tsl,2050-2065;1Pun,2565;	1Pun,2200-2210,2230;Tsl 2220;	1Pun,2200-2210;Tsl,2220-2240,2255-2265;
ML15E		Qlts,1590-1595;	Qas,175-200,210-215,530-535;1PPo,560;

(TABLE 8. Cont'd.)

	^{208}Tl	^{214}Bi	$^{214}Bi/^{208}Tl$
ML15W	Qas,8995-9015;Qag,9205-9215,9235-9275;Qlc,9970-9980;T2rf,9995-10000;	Qas,8995-9010;Qag,9245-9250;Qlc,9960-9970;T2rp 10095-10100;	1Pcr,8310;Tsl,8550;
ML16E	Qas,7150-7155;	Qlts,5855-5865,5875-5890;	Qas,7210-7230;
ML16W	1PPo,6420-6445;Qa,7355-7360;T2rf,8150-8165;1Pcr 8200-8210;	1PPo,6400,6420-6425;pЄh 6590-6605,6980-6985, 7705,pЄdc,7080-7090, 7785-7795;T2rf,8160;	pЄh,6655,6710-6720,7700-7710;1PЄi,6665-6675;[Qa, 7380-7385;] 1Pun,7915;T2rf, 7925-7940;
ML17E	1PPo,4650-4655;		[Qltg,4635-4640;1PPo, 4800-4805;]Qas,5230-5240, 5250-5255,5295-5325;Єsc, 5335;
ML17W	T2rf,3185-3190,3215-3250,3290-3295;Qas,3560-3565;1PPo,4080-4085;	T2rf,3235-3250;	
ML18E	Tsl,2835-2840,2850-2855; Sl,3190-3195;1PPo,3550-3560,3590-3605;		[Єn,3040;] Qas,3055,3080-3085;
ML18W	1PPo,970-985;Qas,2390-2405,2430-2440,2460-2510,2520-2560,2600-2640;Qag,1315-1320,1505-1515;Mc,2725-2740;	Qas,2460-2470,2540-2570	Qag,1005-1010;1PPo,1415-1430;Qag,1815-1820;[Mc, 2760-2790;]
TL1N	Tsl,1560-1595;Qay,2415-2420;Qas,2485-2490,2505-2550;T2rf,2715-2765,2785 -2790;	Tsl,1565-1580;Qas,2520-2525,2540-2565,2625-2635,2715-2745,2765-2770;	
TL1S	Qlso,5000-5015;	Qlsa,5005;	Qlts,5060-5075;
TL2	Qas,520-530,540,570-580, 1035-1060;pЄdc,1120-1140 1150-1155;	Qag,110-130;Mc,400-420, 445-450;Qas,570-575; pЄdc,1150-1155;pЄh, 1220-1225;	Qag,380;1PPo,445,755-760;
TL3N	Qas,3785-3800,Qag,3765-3775;1PPo,3405-3410, 3440-3445;	Qag,3775-3785;Qas,3795-3805;	
TL3S			
TL4	1PPo,2750-2760;		Qag,1800-1810;

(TABLE 8. Cont'd.)

	$^{208}T\ell$	^{214}Bi	$^{214}Bi/^{208}T\ell$
TL5N			Qlcs,1110-1115,1135-1140;
TL5S			Qbi,10-20,95-100,260,380-400,820,855;Qlcs,650-660,670,685,695-710,730,870-880,890-895,950,965-970,1110-1115,1150-1155;lPPo,1225-1230;Qltg,1395-1400;
TL6			Qas,710-715;Qlcs,1050;Qlo,1140-1145;
TL7	pЄbc,475-480;Qas,2015-2025,2035-2045,2130-2140;	Qas,2025-2045,2115,2125-2140;	Mgb,1310;
TL8	lPPo,960-965;	Qlcs,95-105;	Qas,545-550,560-565;lPPo,1100-1120;
TL9	Tsl,2550-2560,2580-2590,2610-2630;	Qlcb,160-175;Qm,1575-1610;	Qas,520,1750-1755,1880;Qm,1580-1595,1600-1605,1635-1640;

[....] Denotes Negative $^{214}Bi/^{208}T\ell$ Anomaly

TABLE 9. Radioactivity Anomalies per Geologic Map Unit

Quaternary Units	^{208}Tl	^{214}Bi	^{214}Bi/^{208}Tl	(-)
Qay	2	2	1	0
Qas	27	22	32	1
Qa	1	0	0	1
Qag	9	7	12	1
Qlc	14	10	11	0
Qltg	3	3	5	1
Qlts	1	3	2	0
Qm	1	2	5	0
Qlcb	0	1	0	0
Qlcs	7	6	38	0
Qlsa	1	1	0	0
Qbi	0	0	14	0
Qlo	0	0	1	0
Tertiary Units				
TQu	1	0	1	0
Tig	0	1	0	0
Tsl	10	7	4	0
T2bf	0	0	1	0
T2rf	8	4	1	0
T2rp	0	1	0	0
Mesozoic Units				
Trt	0	0	1	0
Paleozoic Units				
Pal	0	0	1	0
lPun	1	2	2	0
lPdc	0	1	0	0
lPcr	1	0	1	0
lPPo	11	3	12	1
lPЄi	0	0	1	0
Mc	1	2	0	1
Mgb	0	1	2	0
Mlp	0	0	1	0
Dg	1	1	1	0
Dsi	0	0	1	0
Sl	1	0	0	0
Єsc	0	1	2	0
Єn	0	0	0	1
Precambrian Units				
pЄf	0	1	0	0
pЄh	4	6	3	1
pЄdc	3	3	1	0
pЄbc	1	0	0	0

(....) Denotes Negative Anomaly

TABLE 10. Statistical Summary of Radioactivity Anomalies by Geologic Unit.

Quaternary Units	^{208}Tl	^{214}Bi	$^{214}Bi/^{208}Tl$	(-)
No. of units w/anomalies	10	10	10	4
No. of anomalies	66	57	121	4
Tertiary Units				
No. of units w/anomalies	3	4	4	0
No. of anomalies	19	13	7	0
Mesozoic Units				
No. of units w/anomalies	0	0	1	0
No. of anomalies	0	0	1	0
Paleozoic Units				
No. of units w/anomalies	6	7	10	2
No. of anomalies	16	11	24	2
Precambrian Units				
No. of units w/anomalies	3	3	2	1
No. of anomalies	8	10	4	1
Total Sample				
No. of units w/anomalies	22	24	27	8
No. of anomalies	109	91	157	8

(....) Denotes Negative Anomaly

the anomalies are thought to be related either to lithology changes within a specific unit, or to the variable water content of the surficial sediments within a particularly unit. ^{214}Bi anomalies coincidences with ratio anomalies are listed in Table 11. The loci where the two sets of anomalies coincide are the most likely to have epigenic concentrations of uranyl ions, either from groundwater or evaporating surface waters.

Tertiary Units: TQu,Tig,Tsl,T2bf,T2rf,T2rp

^{208}Tℓ Anomalies

Approximately seventeen percent of the ^{208}Tℓ anomalies occur in the Tertiary geologic map units. Most occur in the Tsl and T2rf units. It is probable that most of these anomalies are associated with litho-changes within the Tertiary units. A high percentage of these ^{208}Tℓ anomalies coincide with ^{214}Bi anomalies.

^{214}Bi and ^{214}Bi/^{208}Tℓ Anomalies

Fourteen percent of the ^{214}Bi and approximately four percent of the positive ratio anomalies occur in the Tertiary units. As is the case with the ^{208}Tℓ anomalies, most of these anomalies occur in the Tsl and T2rf units. Only one ^{214}Bi anomaly coincides with the location of a ratio anomaly; this coincidence occurs at ML14W, station 2220.

Mesozoic Units: Trt

^{214}Bi/^{208}Tℓ Anomaly

Only one radioactivity anomaly occurs in the Mesozoic units. This solitary ratio anomaly occurs in the Triassic aged Thaynes Group.

Paleozoic Units: Pal,lPun,lPdc,lPcr,lPPo,lPЄi,Mc,Mgb,Mlp,
Dg,Dsi,Sl,Єsc,Єn

^{208}Tℓ Anomalies

Approximately fourteen percent of the ^{208}Tℓ anomalies occur in the Paleozoic units. Most of these anomalies occur in the Permian-Pennsylvanian sediments of the Oquirrh Group. Most of the anomalies appear to be associated with litho-changes within the geologic map units.

^{214}Bi and ^{214}Bi/^{208}Tℓ Anomalies

Twelve percent of the ^{214}Bi anomalies and fifteen percent of the ratio anomalies are recorded in the Paleozoic units. Coincidences between the ^{214}Bi anomalies and the ratio anomalies are shown in Table 12. The locations where the coincidences occur are most likely to have epigenic concentrations of uranyl ions. However, some of the Paleozoic units may have veins transecting their strata. The phosphate-rich beds of the Phosphoria Formation do not appear as ^{214}Bi or ratio anomalies.

Precambrian Units: pЄf,pЄh,pЄdd,pЄbc

TABLE 11. Locations where ^{214}Bi Anomalies in Quaternary Geologic Units Coincide with ^{214}Bi/^{208}Tℓ Anomalies.

Geologic Unit	Flight Line	Station(s)
Qlcs	ML6E	240-280
Qay	ML8E	3165-3195
Qm	ML9E	110-160
Qm	TL9	1580-1595
Qm	TL9	1600-1605

TABLE 12. Locations of Paleozoic Geologic Map Units where ^{214}Bi and ^{214}Bi/^{208}Tℓ Anomalies Coincide.

Geologic Unit	Flight Line	Station(s)
Mgb	ML5E	2880
Ꞓsc	ML5E	3065-3070
lPun	ML14W	2200-2210
lPPo	TL2	445

^{208}Tl Anomalies

Seven percent of the ^{208}Tl anomalies occur in the Precambrian units. Most of these anomalies are in the Harrison and Dove Creek formations. Only two of the ^{208}Tl anomalies coincide with ^{214}Bi anomalies, and one at ML11W, stations 7285-7290 (p6h) coincides with a ratio anomaly. The latter anomaly may be of some significance.

^{214}Bi and $^{214}Bi/^{208}Tl$ Anomalies

Eleven percent of the ^{214}Bi anomalies and two percent of the positive ratio anomalies occur in the Precambrian units. Most of these anomalies are in the Harrison and Dove Creek formations. Only one ^{214}Bi anomaly coincides with a ratio anomaly. This occurs at ML16W, station 7705, which is in the Harrison Formation (p6h).

Relationship of Radioactivity Anomalies to Known Radioactive Mineral Deposits

Uranium

The most significant known uranium concentrations in the surveyed area are low-grade concentrations in the phosphatic units of the Phosphoria Formation. Only one anomaly occurs in the Phosphoria; this anomaly is in a lPcr unit at ML15, station 8310, and is a $^{214}Bi/^{208}Tl$ anomaly.

Relationship of the Radioactivity Anomalies and Cultural Features

^{208}Tl Anomalies

The large ^{208}Tl anomaly on ML5E, stations 3750-3820, partially coincides with U.S. Highway 30S.

^{214}Bi Anomalies

The anomalies on ML5E, stations 3750-3800; ML8E, stations 3165-3200; ML9E, stations 110-190, appear to coincide, partially, with paved highways.

$^{214}Bi/^{208}Tl$ Anomalies

Anomalies on ML8E, stations 3165-3200, and on ML9E, stations 110-160, coincide in part with, or are near to, paved highways.

Trends

^{208}Tl Anomalies

The ^{208}Tl anomalies are very unevenly distributed throughout the map area, indeed large sections of the central portion of the map area are devoid of anomalies. Many of the existing anomalies are concentrated into groups, some of which coincide with topographic-physiographic features. Five clusters are described. The most easterly cluster is in the southernmost part of Blue Creek Valley, sandwiched between the North Promontory Mountains and the Blue Spring Hills; the anomalies are mainly in Quaternary sediments. A rather scattered group of anomalies is distributed throughout the Raft River Mountains, generally in Precambrian units. A third group exists in the Grouse Creek Mountains, where they crop-out in Precambrian units. To the northwest, a small, compact cluster occurs on the northwestern flank of the Goose Creek Mountains. A cluster in the eastcentral part of the area coincides with the exposures of Quaternary and Tertiary rocks in Grouse Creek Valley.

^{214}Bi Anomalies

The ^{214}Bi anomalies are sparsely and unevenly scattered throughout the map sheet area. Three clusters can be identified. In the east, to the north, south and west of Brigham City, anomalies exist in a variety of Quaternary units. In the westcentral area, one group of ^{214}Bi anomalies coincides with Paleozoic rocks and flanking Quaternary sediments of the Grouse Creek Mountains; whereas, a second cluster coincides with the Quaternary sediments and Tertiary volcanics of Grouse Creek Valley.

^{214}Bi/^{208}Tℓ Anomalies

The ratio anomalies are more evenly distributed throughout the area than either the ^{208}Tℓ or the ^{214}Bi anomalies. However, groups of anomalies exist. A linear group extends along the western side of the Great Salt Lake, mainly in Quaternary sediments. Well developed anomalies lie peripheral to the Lakeside Mountains, some of these anomalies are in Quaternary sediments, others in Paleozoic strata. On the western side of the Great Salt Lake, there are a group of anomalies associated with the South Promontory Mountains, mainly in Upper Paleozoic units. A linear grouping of anomalies occurs in the Quaternary sediments to the north and south of Brigham City.

3. Summary and Recommendations

A majority of the ^{208}Tℓ, ^{214}Bi and ratio anomalies occur in Quaternary sediments. When only Quaternary units are considered, the number of ratio anomalies is approximately twice as great as the number of ^{214}Bi or ^{208}Tℓ anomalies. The Quaternary units with the highest aggregates of anomalies are: Qas, Qag, Qlc, Qlcs and Qbi - the unit Qbi has only ratio anomalies. A very high percentage of the ^{214}Bi and ^{208}Tℓ anomalies in Quaternary units are thought to reflect intra-unit changes in lithology.

The number of ratio anomalies in non-Quaternary aged units is very low; the highest aggregates of ratio anomalies to occur in non-Quaternary units are located in the lPPo (12), Tsl (4), and p6f (3) units; only one of these ratio anomalies coincides with a ^{214}Bi anomaly.

The distribution of the three sets of radioactivity anomalies is uneven, and the anomalies tend to form clusters or linear groups. The greatest coincidence between the locations of the ^{214}Bi and the ^{208}Tℓ clusters of anomalies occurs in the northwest in the vicinity of Grouse Creek Valley.

There appears to be minimal relationship between the location of radioactivity anomalies and the occurrence of cultural features. Low-grade uranium ore concentrations are known to occur in the phosphatic units of the Phosphoria Formation; however, only one ratio anomaly is associated with the Phosphoria.

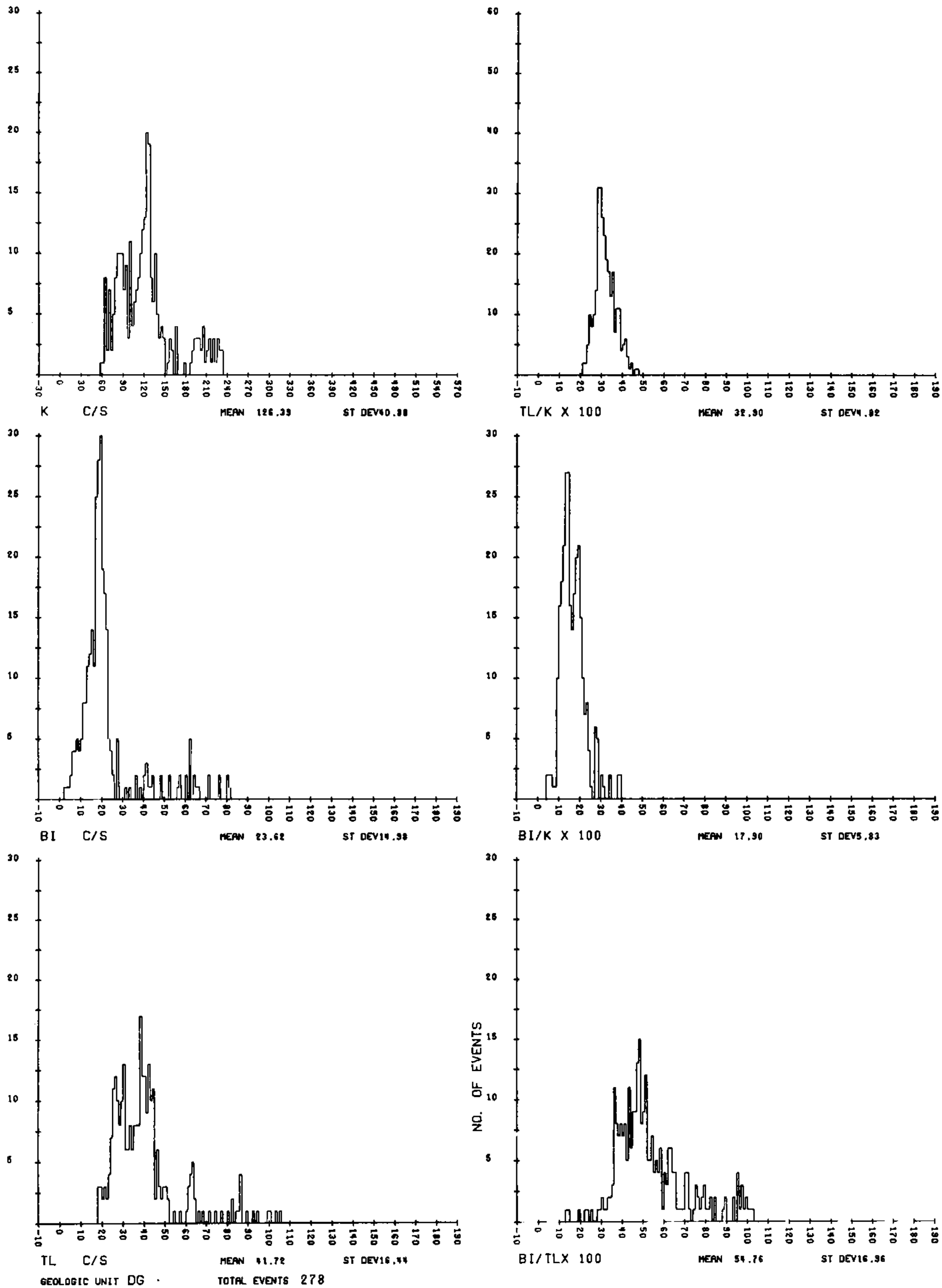
APPENDIX I

FREQUENCY DISTRIBUTION OF RADIATION DATA AS A FUNCTION OF GEOLOGIC UNIT

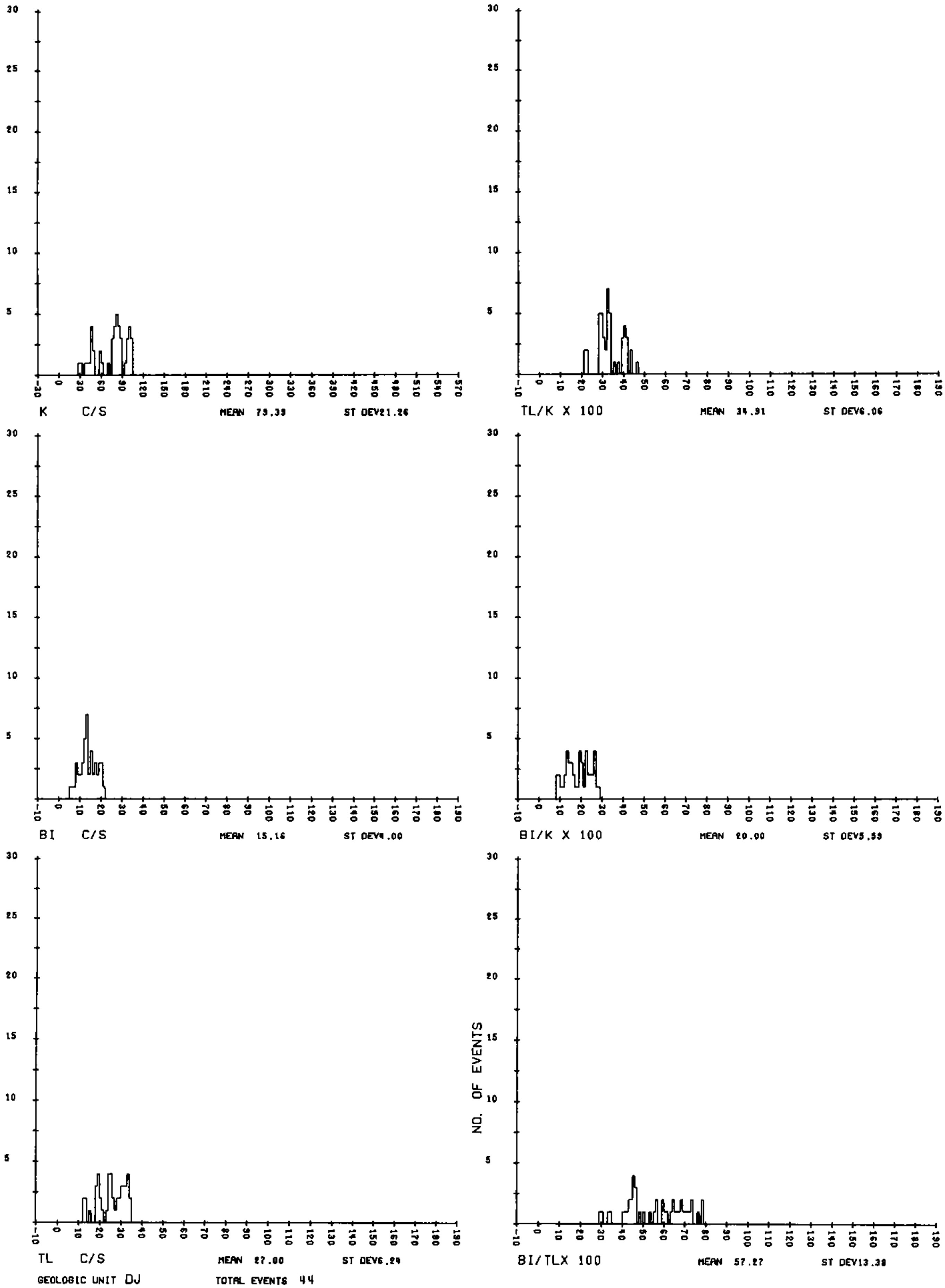
Tℓ		Bi		K		Bi/Tℓ		Bi/K		Tℓ/K		NO. EVENTS	GEOL. UNIT
σ	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$		
16.4383	41.7	14.9830	23.6	40.8799	126.4	0.1696	0.5476	0.0583	0.1790	0.0482	0.3290	278.0	DG
6.2431	27.0	4.0026	15.2	21.2605	79.4	0.1338	0.5727	0.0559	0.2000	0.0606	0.3491	44.0	DJ
5.0538	18.1	3.5295	14.6	17.2163	53.0	0.2659	0.8448	0.0784	0.2890	0.0463	0.3471	21.0	DSI
4.2762	16.4	4.2622	14.0	9.7334	56.3	0.2058	0.8414	0.0758	0.2500	0.0861	0.3000	7.0	DWC
3.2502	25.3	1.7302	18.1	11.6322	78.8	0.1334	0.7254	0.0339	0.2315	0.0681	0.3285	13.0	GB
2.6191	34.8	3.6545	16.1	10.2547	78.4	0.0809	0.4613	0.0457	0.2074	0.0412	0.4478	23.0	GMI
7.8761	31.6	3.3935	14.8	20.2558	94.8	0.1765	0.4964	0.0610	0.1651	0.0554	0.3368	109.0	GMJ
6.5885	37.7	3.1970	17.5	11.4841	99.7	0.0994	0.4737	0.0356	0.1770	0.0414	0.3774	27.0	GMU
24.2757	46.3	7.1774	18.5	37.7636	120.9	0.1803	0.4552	0.0542	0.1572	0.1132	0.3660	141.0	GN
6.9956	33.3	4.4608	15.1	23.9037	93.4	0.1463	0.4684	0.0695	0.1737	0.0770	0.3689	93.0	GPM
13.2976	49.5	10.8590	21.2	21.4203	111.9	0.5196	0.5288	0.1910	0.2172	0.0517	0.4364	50.0	GSC
14.2027	39.8	3.0673	14.7	16.7107	116.1	0.1148	0.3959	0.0300	0.1282	0.1018	0.3429	17.0	GUN
5.8723	30.0	6.3439	24.8	12.3190	84.3	0.3132	0.8708	0.0853	0.3001	0.0554	0.3568	108.0	IPCGR
3.6226	27.6	3.5768	32.7	12.8663	95.0	0.1565	1.1984	0.0466	0.3488	0.0221	0.2912	25.0	IPCMP
16.2027	39.0	5.5163	19.3	31.1978	94.1	0.1904	0.5439	0.0689	0.2173	0.0716	0.4098	473.0	IPCR
6.3476	26.5	4.2403	14.6	17.4954	95.9	0.1568	0.5634	0.0454	0.1550	0.0584	0.2793	224.0	IPDC
18.5764	68.4	8.7308	23.8	21.2995	135.8	0.0944	0.3518	0.0565	0.1751	0.1202	0.5048	61.0	IPEI
7.7920	28.9	3.3984	17.7	17.7821	84.2	0.2014	0.6506	0.0510	0.2162	0.0540	0.3417	126.0	IPG
3.2660	35.7	2.6824	15.9	3.3352	71.9	0.0756	0.4460	0.0339	0.2207	0.0401	0.4960	15.0	IPMMC
5.0625	59.4	2.1981	18.6	9.4143	146.5	0.0513	0.3170	0.0173	0.1275	0.0342	0.4065	20.0	IPO
8.9085	70.9	4.7243	21.8	17.0106	158.9	0.0616	0.3089	0.0259	0.1378	0.0251	0.4456	9.0	IPPL
9.8275	33.2	4.2957	16.3	27.3185	102.5	0.1771	0.5223	0.0688	0.1709	0.0737	0.3306	5886.0	IPPO
5.6847	27.0	4.5385	18.8	13.9942	109.1	0.2990	0.7342	0.0782	0.1776	0.0330	0.2457	67.0	IPPU
10.2925	34.4	6.4909	19.6	25.6780	90.0	0.1707	0.5906	0.0900	0.2302	0.0988	0.3936	412.0	IPUN
4.8959	17.8	5.5814	12.8	21.2232	65.7	0.2019	0.7017	0.0392	0.1892	0.0539	0.2800	12.0	MB
10.2811	38.5	5.4848	19.3	27.7008	129.4	0.1288	0.5175	0.0367	0.1508	0.0545	0.2974	238.0	MC
5.4920	21.6	4.1757	16.0	20.9699	65.5	0.2989	0.7883	0.1134	0.2687	0.0658	0.3423	319.0	MGB
2.1203	34.9	4.0494	19.7	12.2935	108.1	0.1150	0.5665	0.0468	0.1861	0.0350	0.3265	31.0	MH
5.8052	21.0	6.6824	19.4	25.9016	74.9	0.2242	0.9364	0.0545	0.2664	0.0623	0.2918	11.0	MLP
2.0246	12.4	2.4103	8.9	5.4761	29.4	0.2069	0.7339	0.0918	0.3157	0.0983	0.4357	28.0	MUN
3.5269	18.8	2.0647	13.5	20.1931	61.3	0.1439	0.7400	0.1562	0.2653	0.1751	0.3542	19.0	OE
4.0671	15.3	3.1836	9.8	13.7319	43.3	0.2884	0.6850	0.0939	0.2446	0.1005	0.3712	26.0	OFH
20.2866	35.7	5.6195	15.0	51.4651	102.7	0.2759	0.5241	0.0998	0.1799	0.0736	0.3464	120.0	OGC
9.6279	24.7	3.4059	14.5	18.8343	86.1	0.4595	0.7169	0.0872	0.1825	0.0712	0.2781	16.0	OSP

TABLE AI-I Summary of Average and Standard Deviation Values for the NTMS as a Function of Geologic Unit.

Tℓ		Bi		K		Bi/Tℓ		Bi/K		Tℓ/K		NO. EVENTS	GEOL. UNIT
σ	X̄	σ	X̄	σ	X̄	σ	X̄	σ	X̄	σ	X̄		
6.8279	23.4	3.7799	12.1	20.0329	73.3	0.1918	0.5453	0.0496	0.1696	0.0601	0.3218	55.0	PAL
6.5956	83.4	2.3503	25.5	4.3039	136.5	0.0468	0.3090	0.0209	0.1870	0.0567	0.6110	20.0	P€BC
24.1810	69.7	7.0482	22.5	34.5554	143.9	0.1082	0.3415	0.0414	0.1589	0.0991	0.4815	1139.0	P€DC
32.4966	74.1	10.2362	26.1	59.8637	162.4	0.1211	0.3760	0.0536	0.1681	0.1166	0.4638	1995.0	P€H
38.0174	104.5	9.4608	30.3	64.6654	190.4	0.1040	0.3159	0.0627	0.1719	0.1193	0.5583	356.0	PEI
5.2560	30.7	2.8818	11.2	22.1662	82.4	0.1047	0.3729	0.0475	0.1443	0.0806	0.3891	150.0	P€M
12.5064	60.4	5.8913	22.9	26.1838	144.8	0.0678	0.3802	0.0397	0.1601	0.0711	0.4210	205.0	P€MF
7.5689	23.8	5.3166	13.2	33.2782	75.4	0.1227	0.5512	0.0467	0.1839	0.0551	0.3364	33.0	PMCD
14.6739	40.2	6.5764	20.2	21.6670	76.5	0.1582	0.5356	0.0984	0.2776	0.1508	0.5279	270.0	PMMC
14.3760	54.9	4.9254	20.2	23.9428	125.8	0.0847	0.3789	0.0314	0.1616	0.0639	0.4340	701.0	QA
18.9315	42.5	6.7082	19.7	34.9516	115.4	0.1655	0.5020	0.0497	0.1762	0.0824	0.3639	4352.0	QAG
16.0636	49.5	5.2833	19.7	27.4000	129.9	0.1148	0.4180	0.0378	0.1542	0.0762	0.3782	15461.0	QAS
13.7140	46.6	20.8778	23.0	27.1043	122.0	1.1878	0.5855	0.4464	0.2171	0.0534	0.3790	1922.0	QAY
6.6447	10.7	4.4457	11.0	19.4021	39.5	0.6187	1.2594	0.1349	0.3147	0.0813	0.2673	302.0	QBI
12.1457	32.7	4.4402	19.7	22.9164	96.6	0.1573	0.6393	0.0453	0.2091	0.0468	0.3331	70.0	QDS
13.5283	45.7	5.0176	21.6	31.3338	127.1	0.1631	0.5018	0.0525	0.1774	0.0568	0.3593	10719.0	QLC
7.4655	17.0	5.0681	13.7	22.0343	54.9	0.4511	0.9169	0.1347	0.2791	0.0929	0.3152	622.0	QLCB
11.8918	31.0	6.4638	18.4	33.5205	92.8	0.2574	0.6497	0.0890	0.2155	0.0535	0.3359	11996.0	QLCS
8.6134	17.4	4.7274	14.0	18.3572	62.4	0.4671	0.9952	0.0865	0.2352	0.0856	0.2661	44.0	QLD
5.6317	17.3	2.9000	10.4	14.4914	64.1	0.1958	0.6309	0.0447	0.1655	0.0478	0.2697	324.0	QLSA
13.9464	35.9	4.9660	17.7	26.2468	107.7	0.1547	0.5253	0.0505	0.1699	0.0739	0.3315	2120.0	QLTG
19.2486	52.5	6.3346	19.9	39.5786	132.2	0.1181	0.4047	0.0482	0.1579	0.0782	0.3960	1292.0	QLTS
9.7587	29.9	59.9529	41.9	29.2214	87.8	2.3249	1.5439	0.8550	0.5432	0.0558	0.3471	2131.0	QM
6.5750	25.3	3.7721	12.5	26.2384	72.3	0.1285	0.5100	0.0672	0.1889	0.0689	0.3689	37.0	QMS
9.4020	19.4	3.3442	11.4	22.5299	56.8	0.2846	0.6750	0.0943	0.2219	0.0597	0.3382	62.0	SL
8.2075	41.2	4.4280	17.7	17.7127	117.3	0.1070	0.4389	0.0331	0.1517	0.0465	0.3509	733.0	T2BF
32.4631	98.6	13.6790	35.9	44.1545	184.5	0.0744	0.3677	0.0452	0.1922	0.0847	0.5259	1157.0	T2RF
25.2298	91.9	10.6924	37.0	31.6711	179.5	0.0625	0.4058	0.0331	0.2039	0.0683	0.5063	171.0	T2RP
16.3837	94.4	6.2297	32.8	26.0174	207.3	0.0513	0.3509	0.0246	0.1586	0.0392	0.4533	109.0	T2RT
21.8952	71.9	8.0511	31.3	38.2463	186.4	0.1520	0.4634	0.0372	0.1692	0.1284	0.3960	173.0	TIG
1.6074	27.6	2.8072	10.6	4.9830	82.3	0.1022	0.3838	0.0321	0.1285	0.0287	0.3372	47.0	TK
12.5911	36.4	4.6088	17.5	27.8341	100.3	0.1541	0.5144	0.0413	0.1800	0.0633	0.3608	335.0	TQU
6.3956	27.6	4.0540	16.5	18.1352	76.6	0.1710	0.6214	0.0682	0.2244	0.0557	0.3634	169.0	TRT
25.8056	57.2	8.6050	23.1	46.0846	128.1	0.1632	0.4348	0.0652	0.1870	0.0872	0.4421	4578.0	TSL



A 1 BRIGHAM CITY



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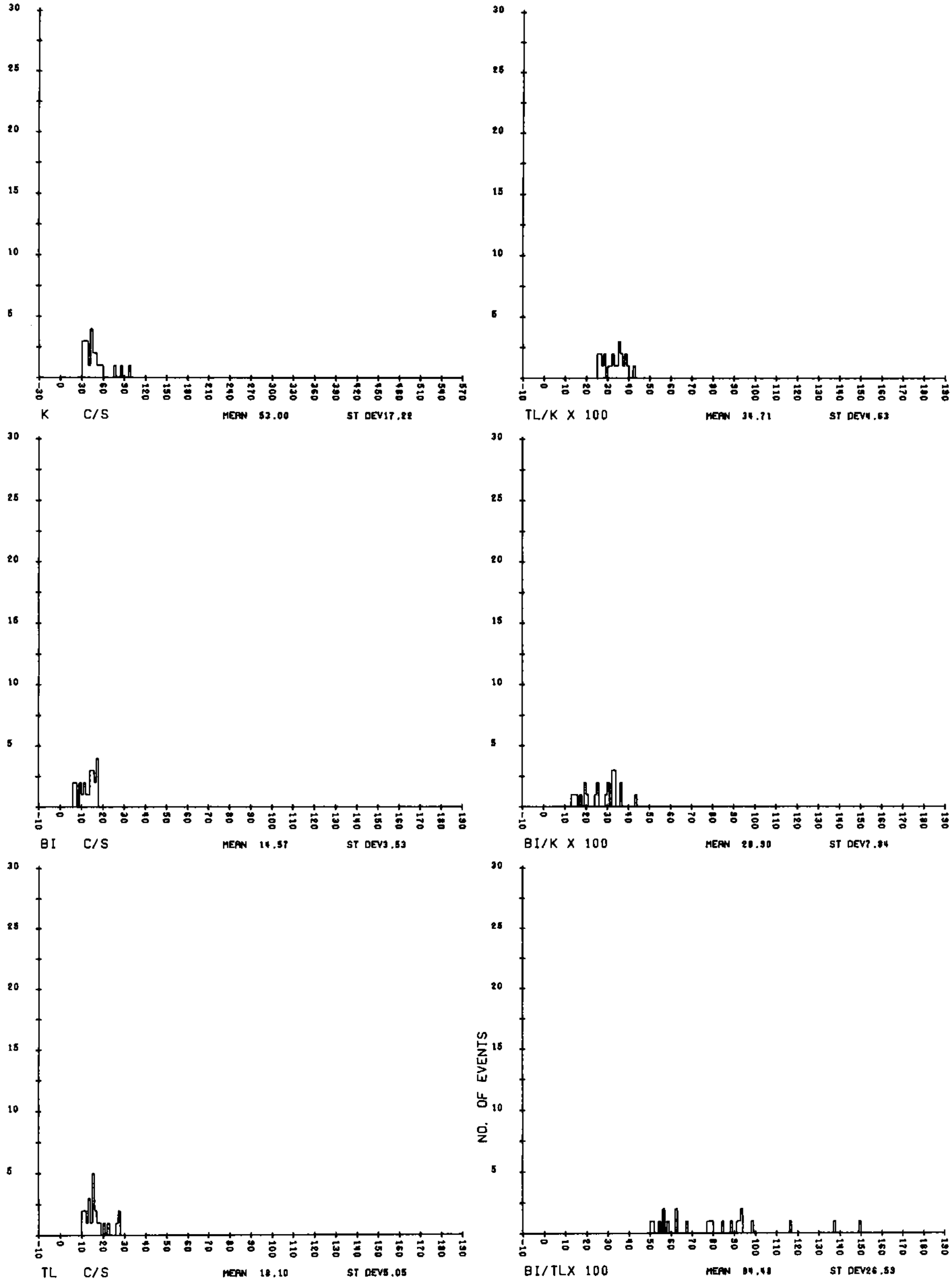
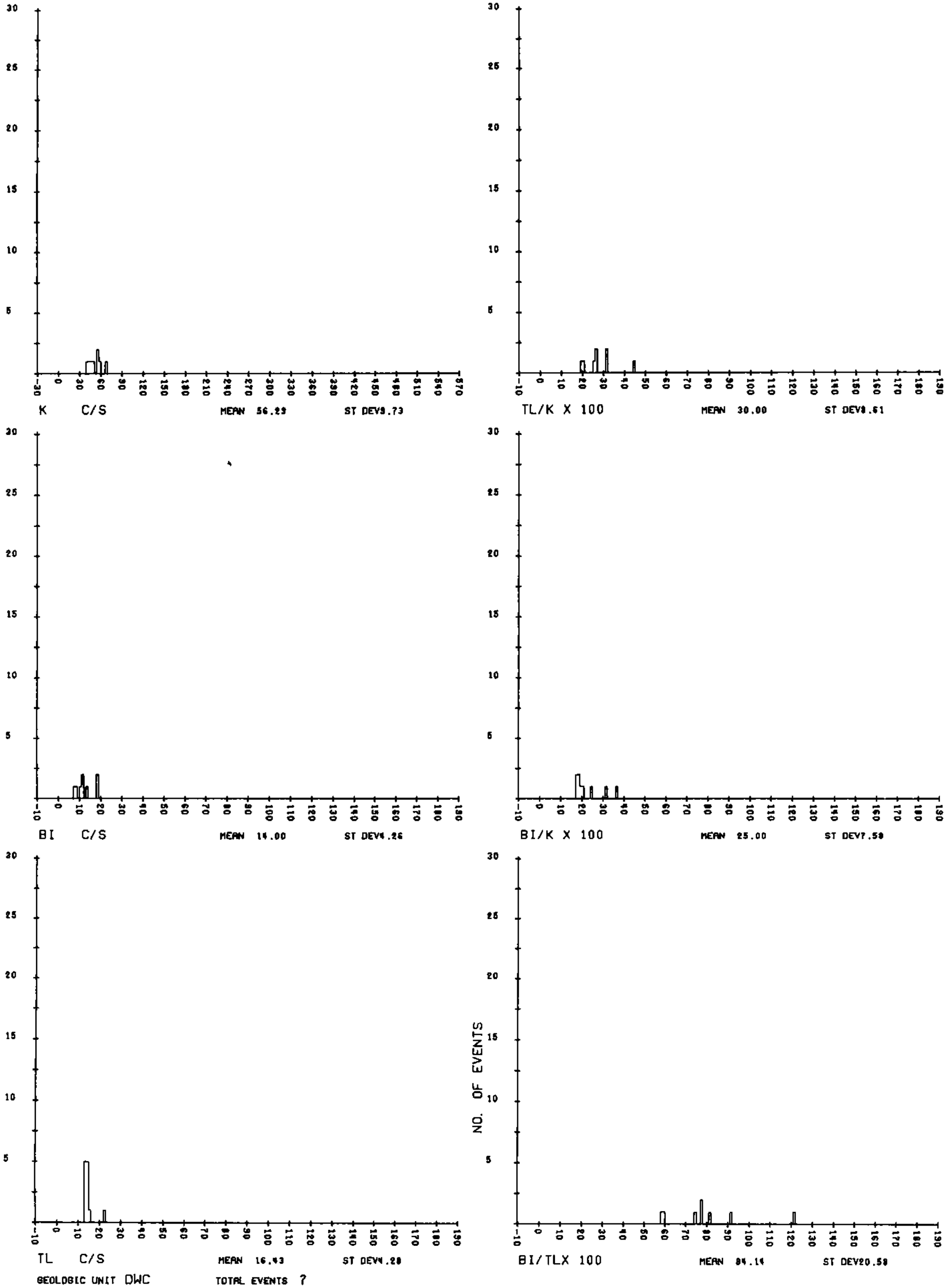


GEOLOGIC UNIT DSI · TOTAL EVENTS 21

A3 BRIGHAM CITY



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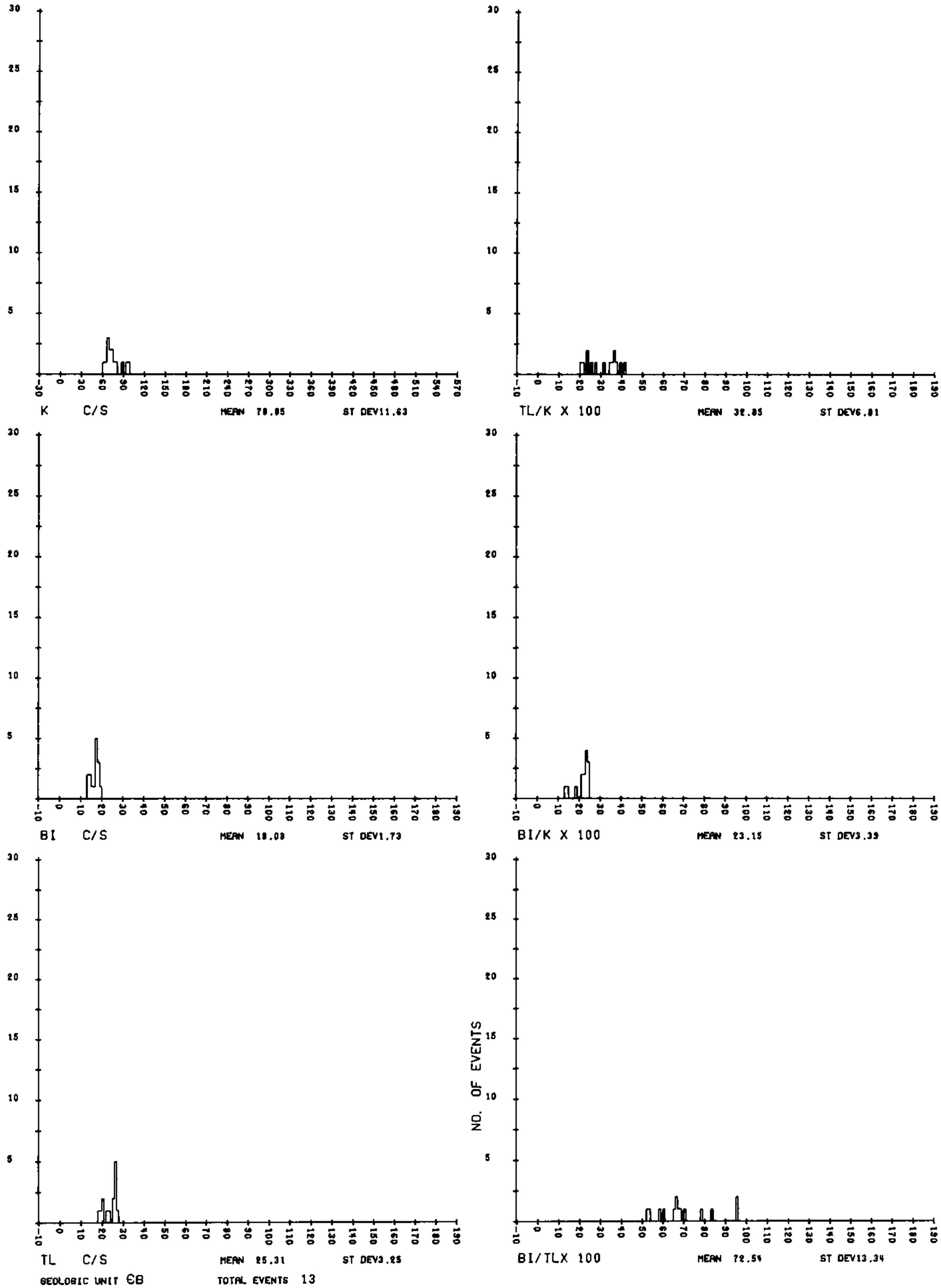

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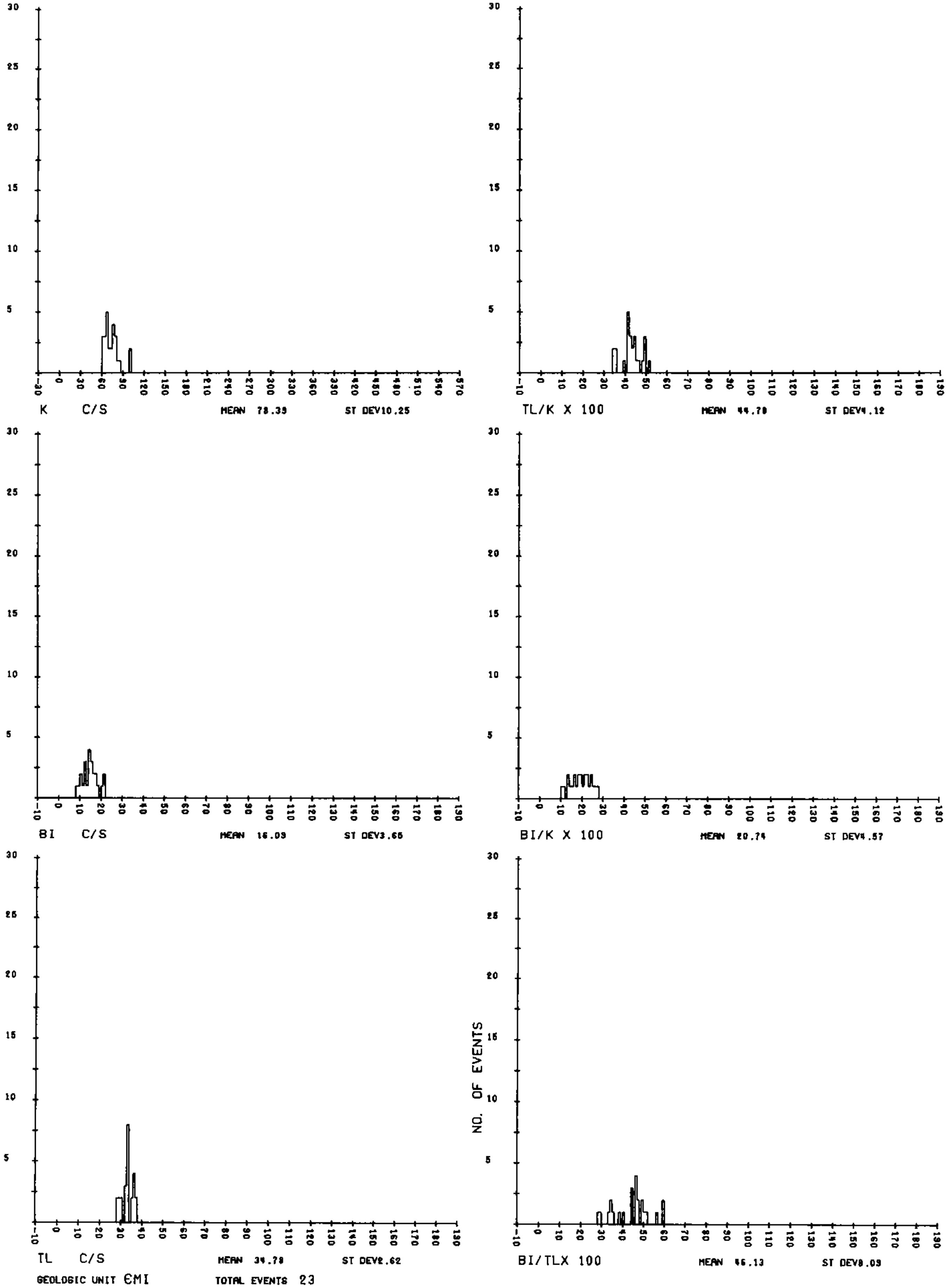

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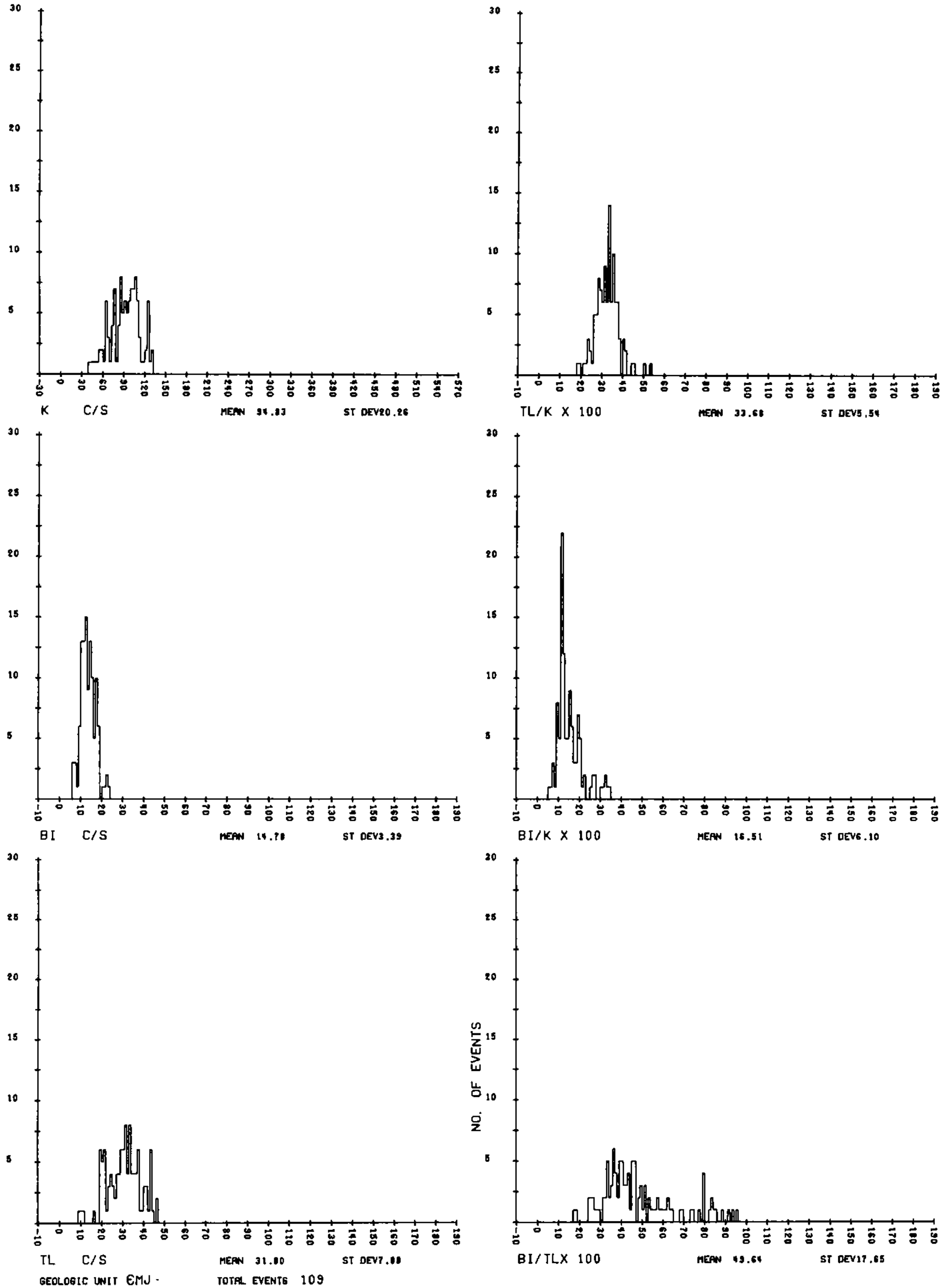
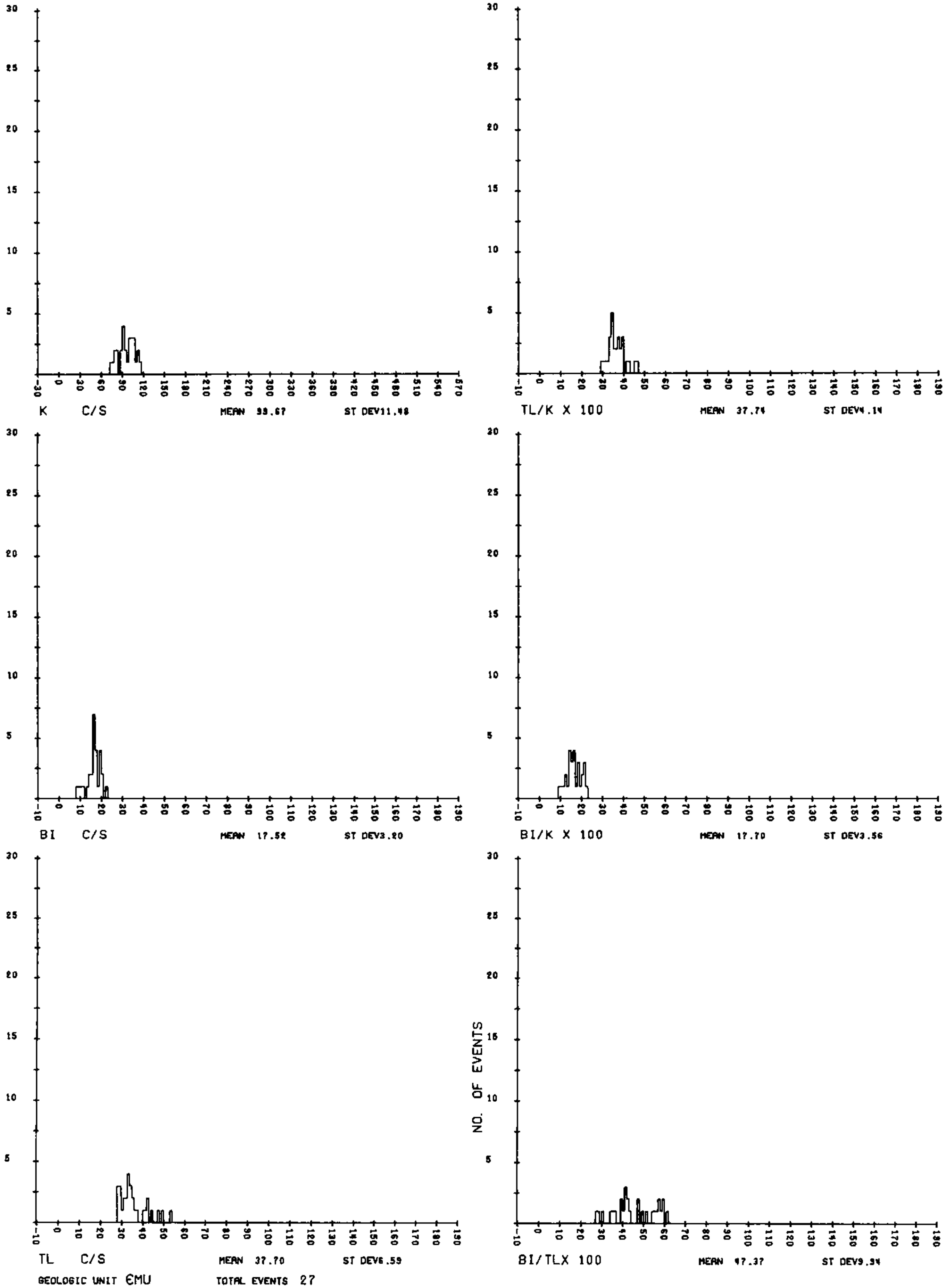
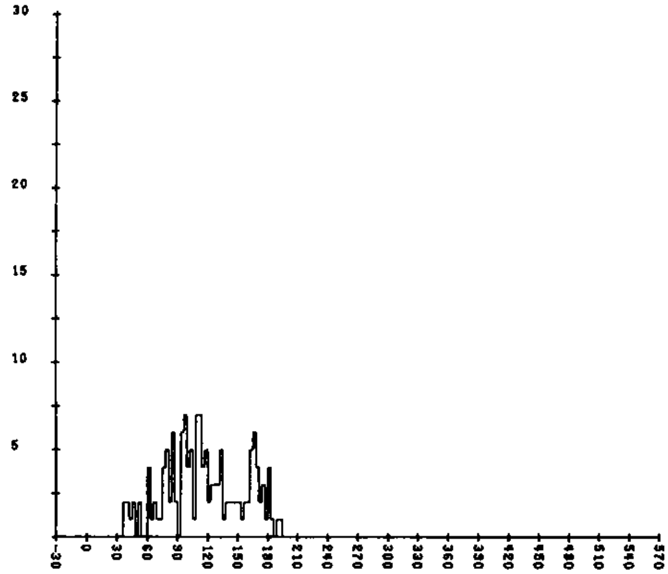


A 7 BRIGHAM CITY



A 8 BRIGHAM CITY



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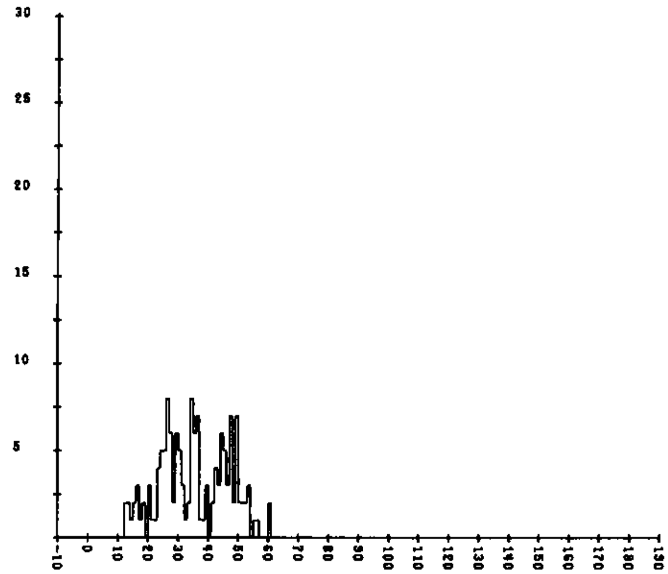

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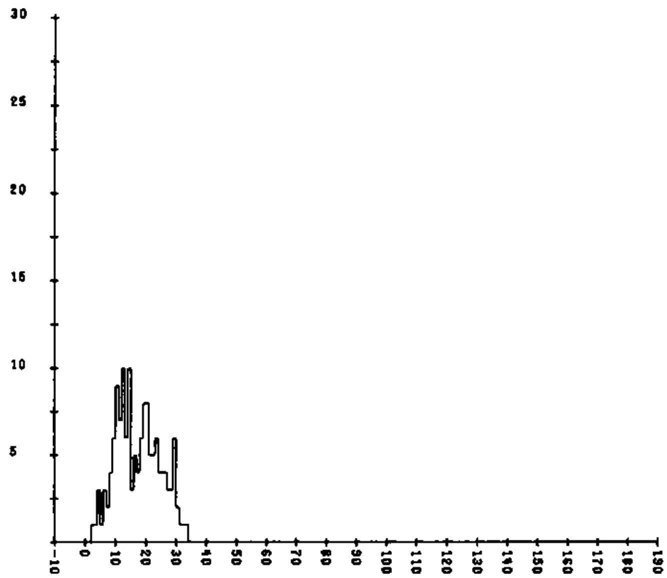
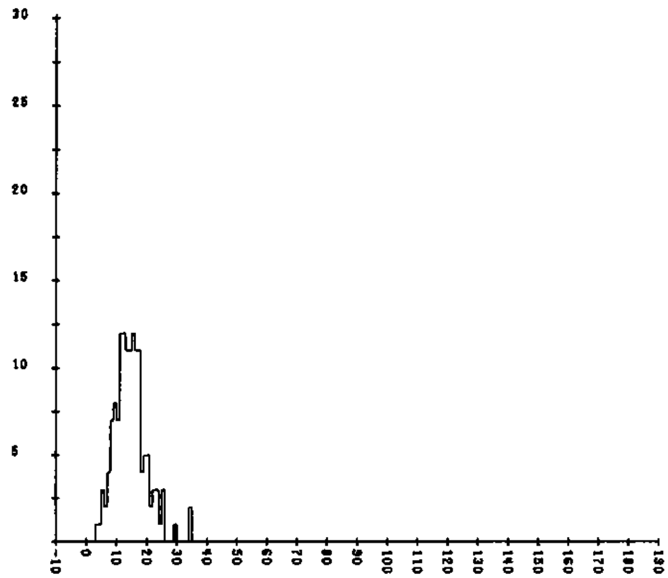
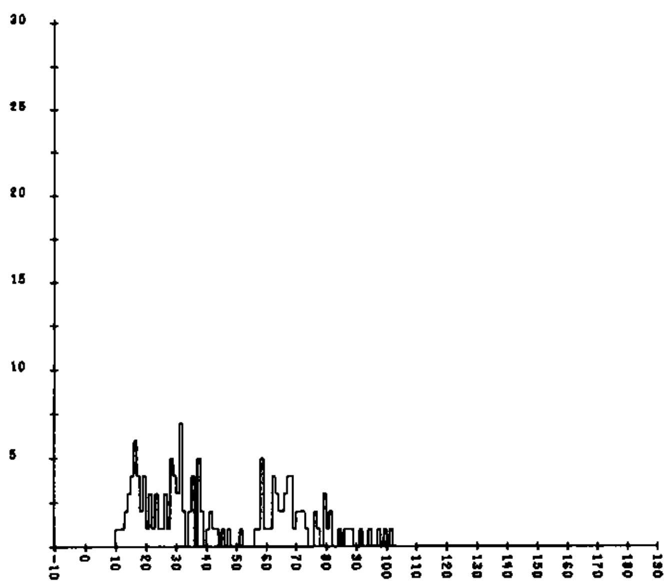


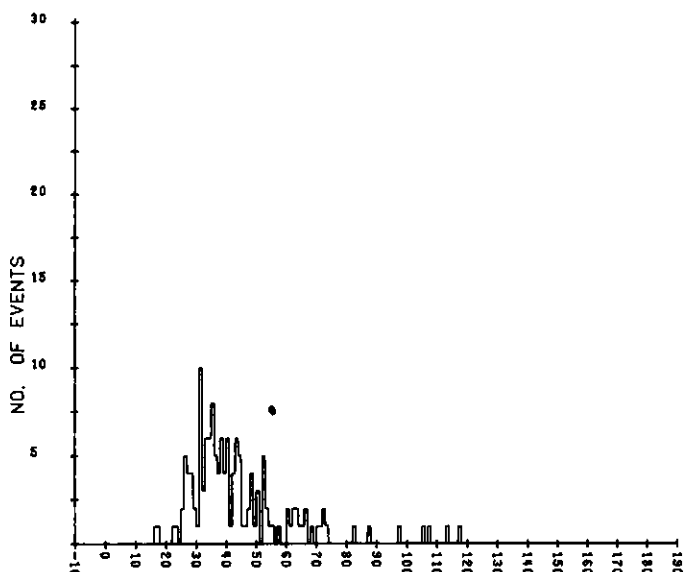
BI C/S MEAN 18.52 ST DEV7.18



BI/K X 100 MEAN 15.72 ST DEV5.42



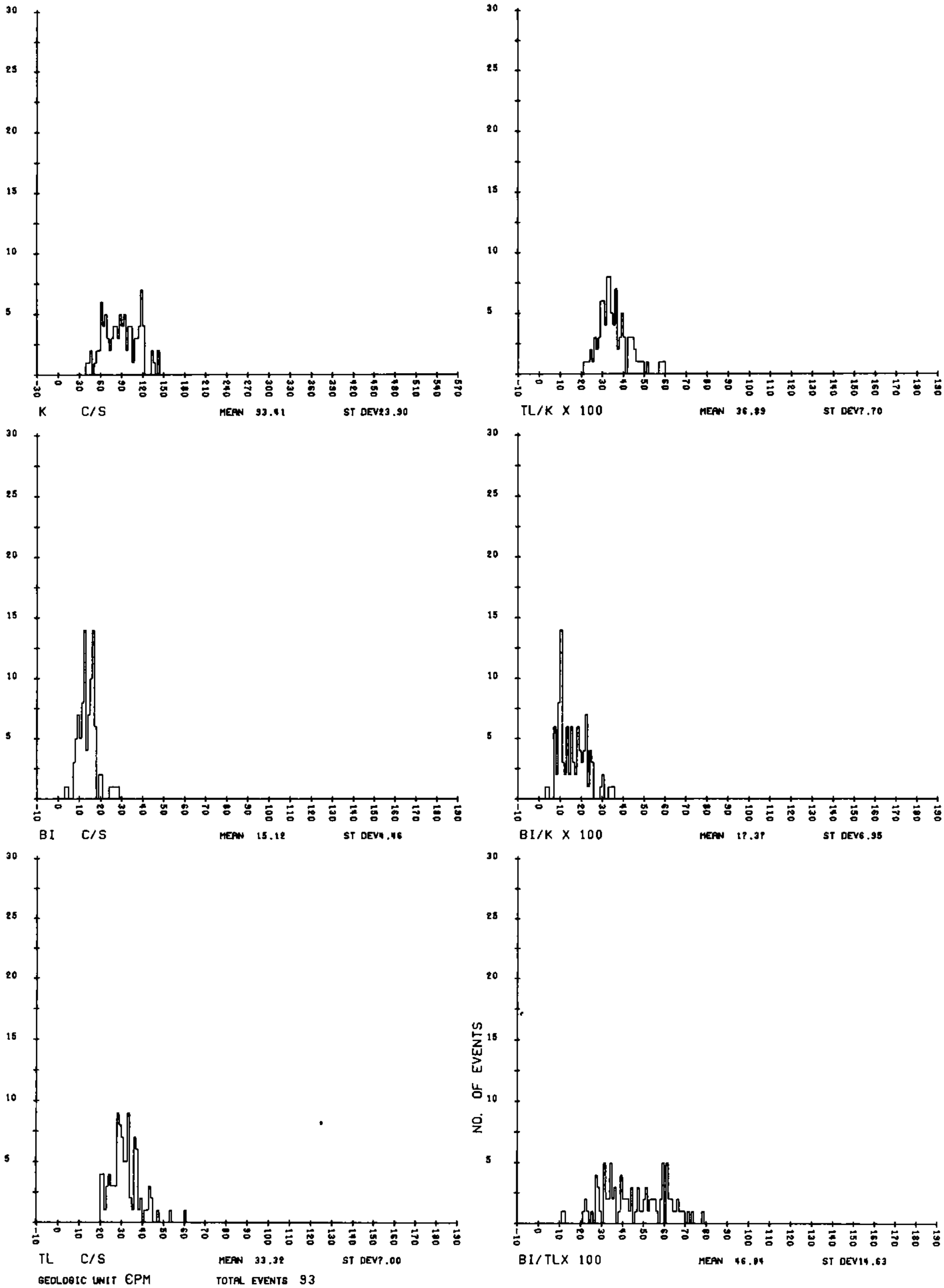
TL C/S MEAN 46.28 ST DEV24.28



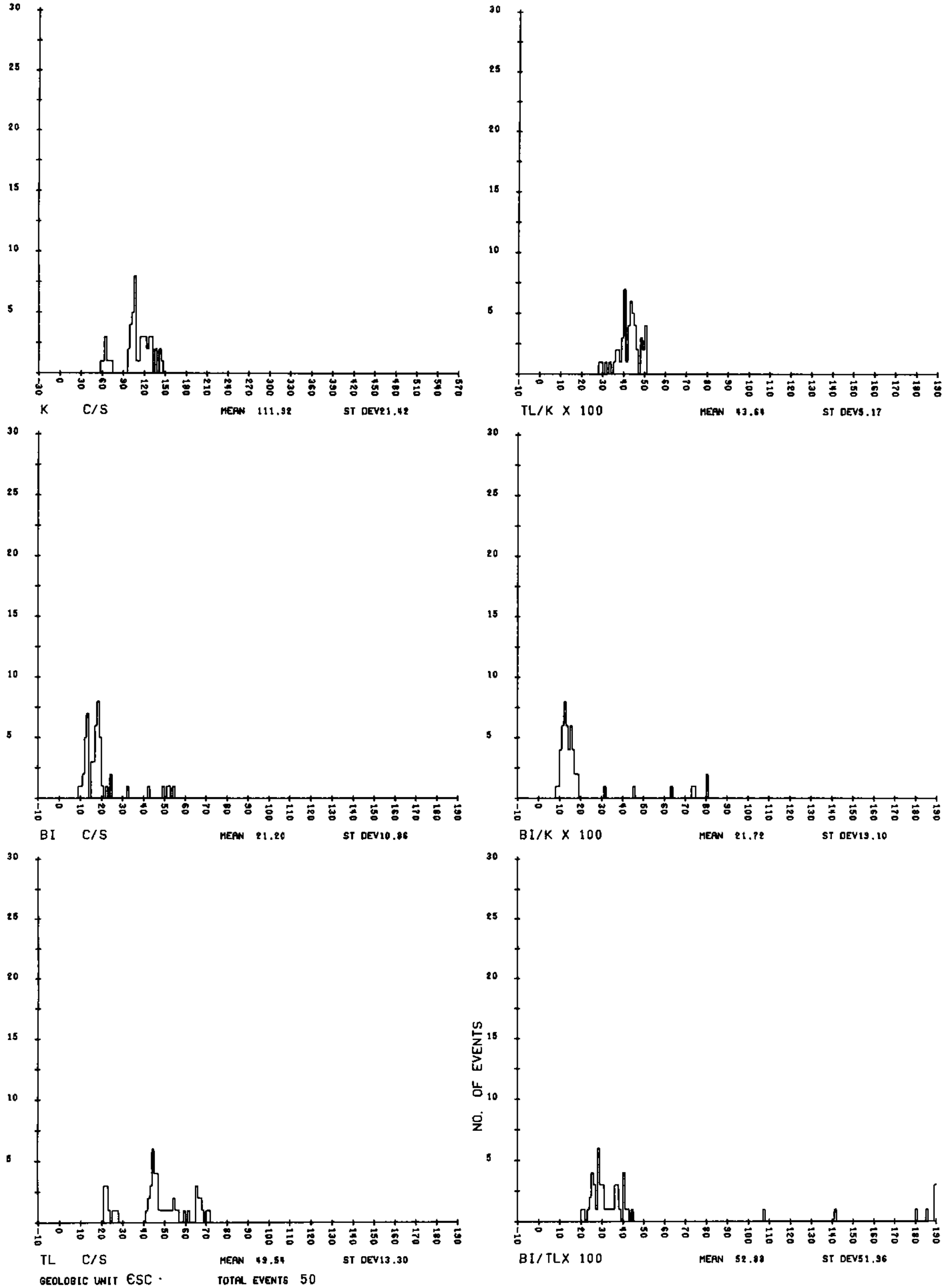
BI/TLX 100 MEAN 45.52 ST DEV18.03

GEOLOGIC UNIT ЄN · TOTAL EVENTS 141

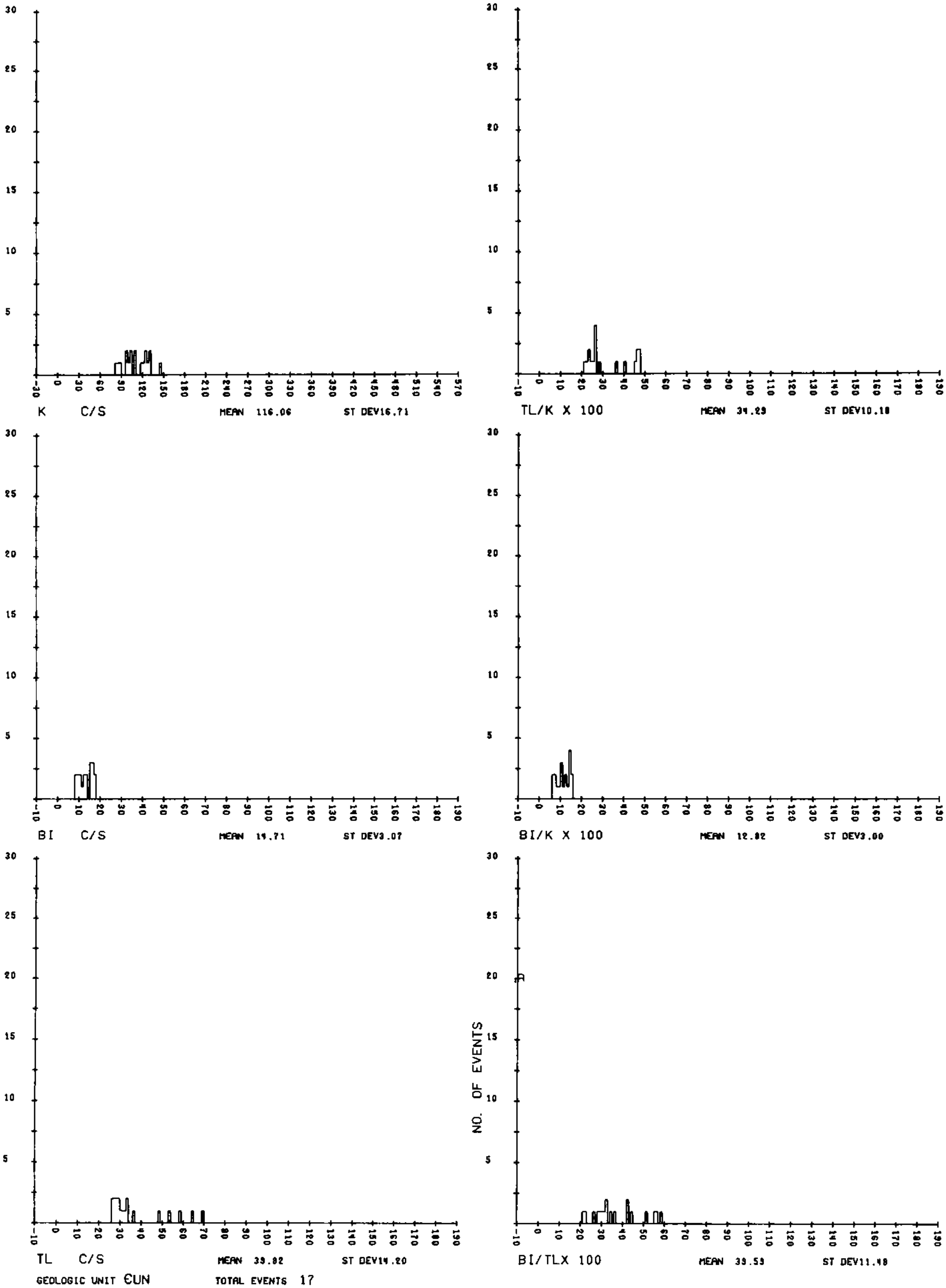
A 9 BRIGHAM CITY



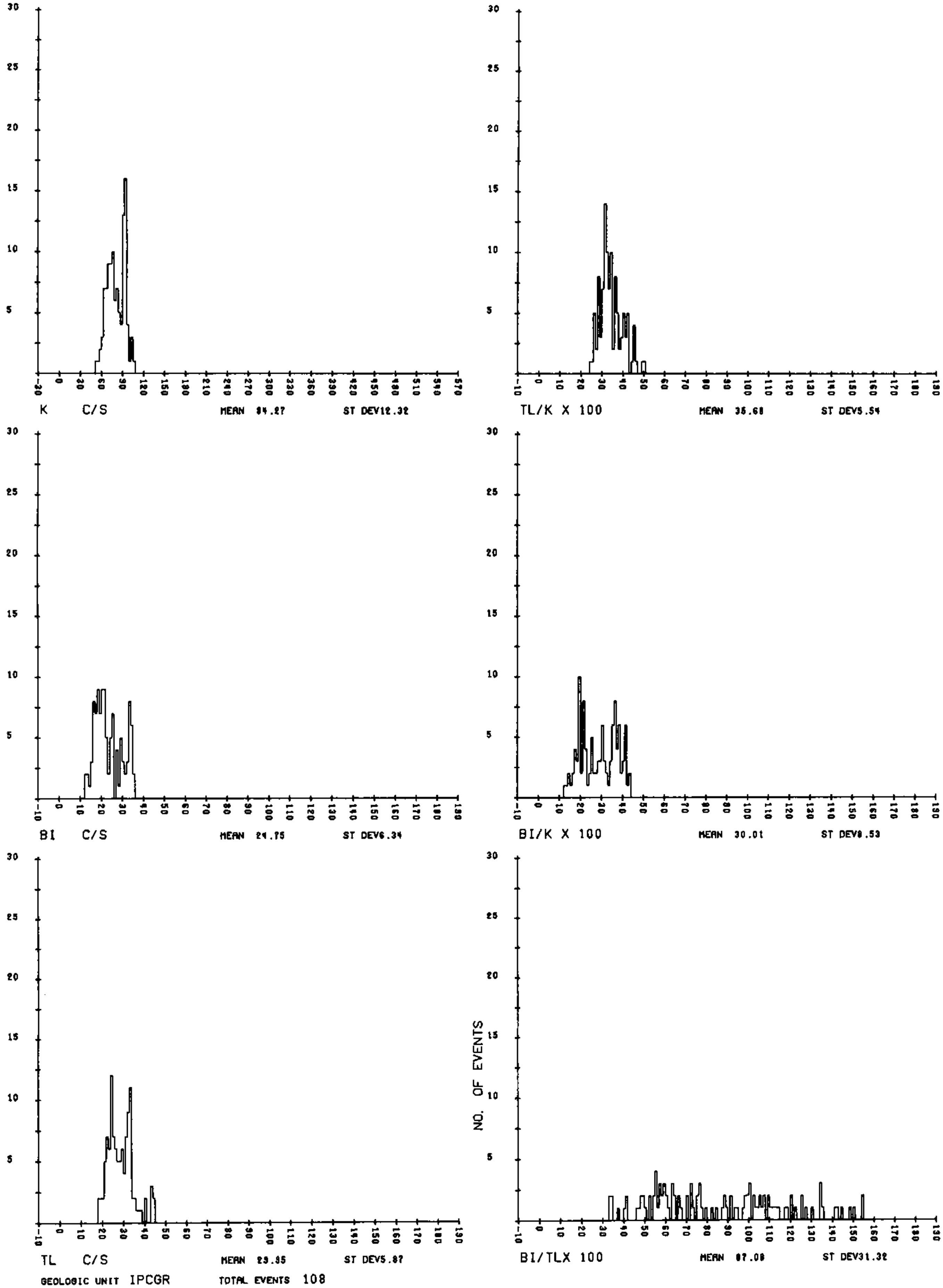
A 10 BRIGHAM CITY



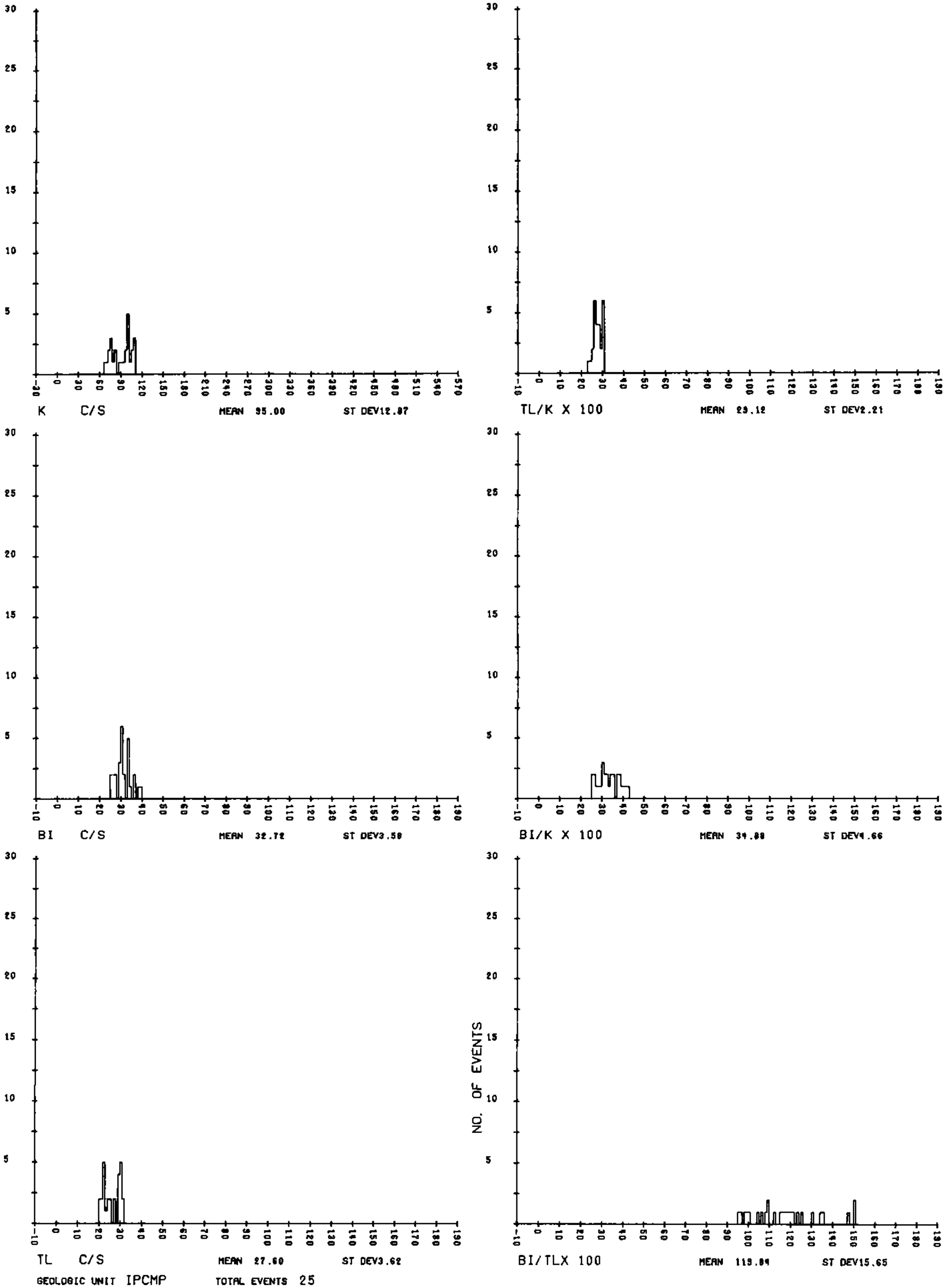
A 11 BRIGHAM CITY



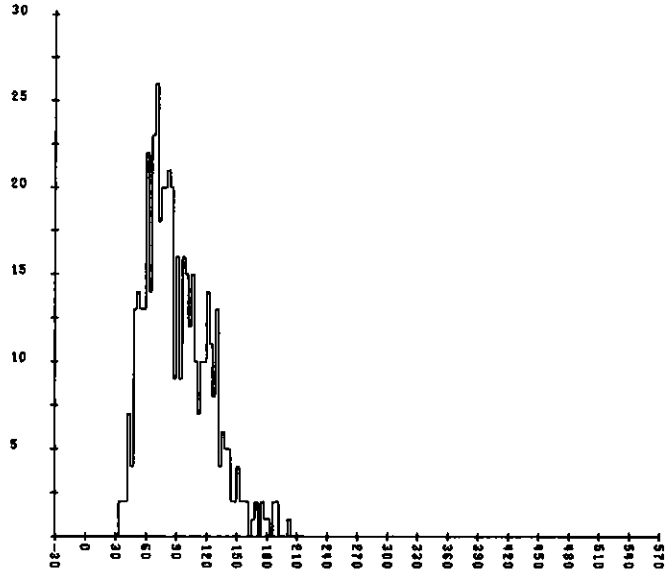
A 12 BRIGHAM CITY



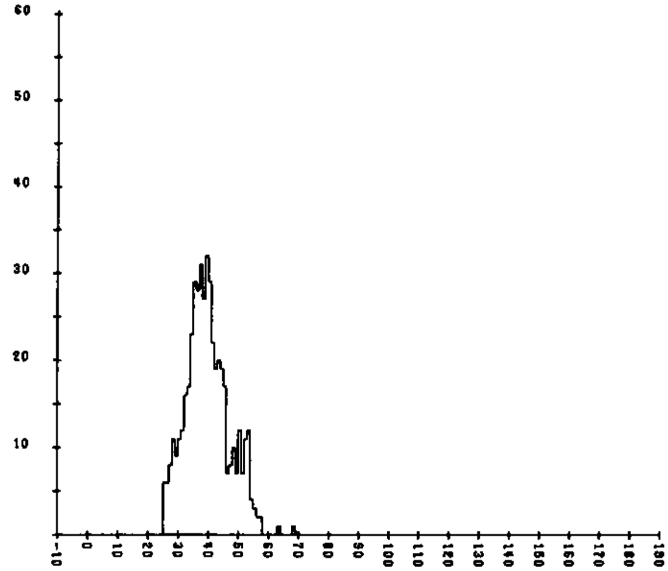
A 13 BRIGHAM CITY



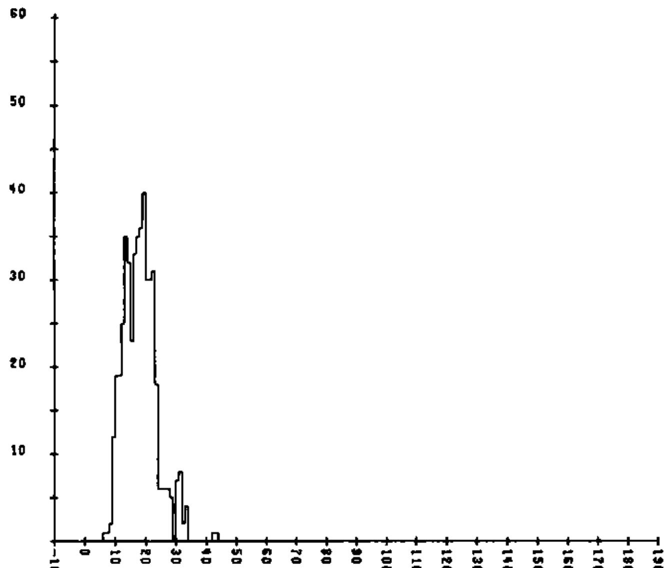
A 14 BRIGHAM CITY



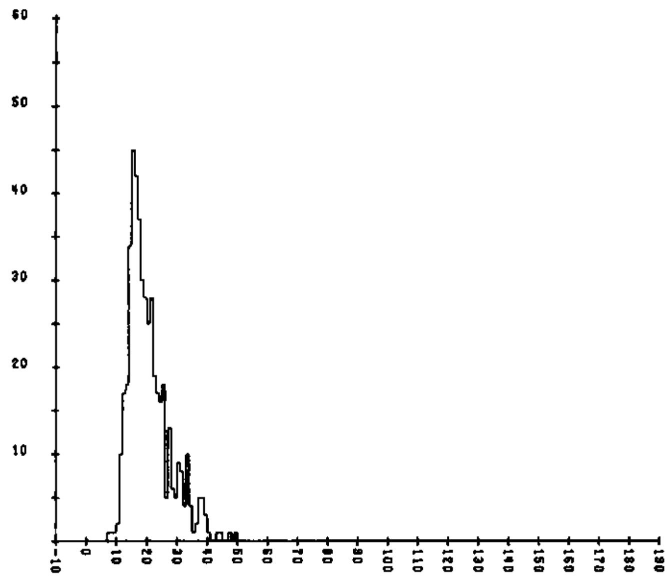
K C/S MEAN 94.13 ST DEV31.20



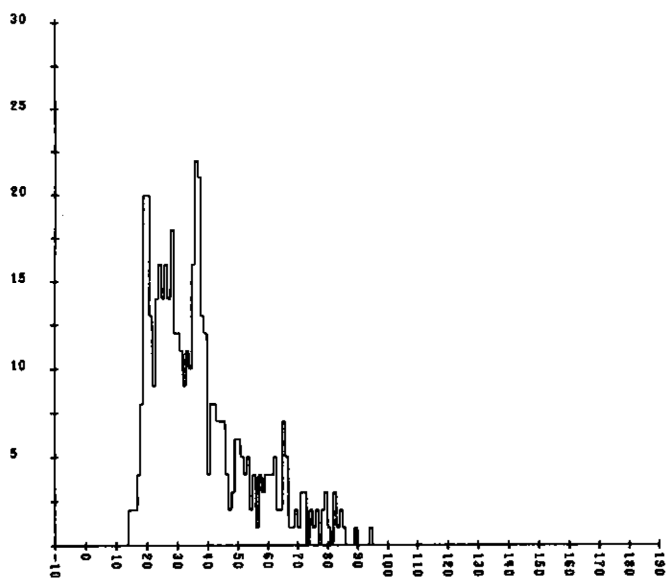
TL/K X 100 MEAN 40.38 ST DEV7.16



BI C/S MEAN 19.29 ST DEV5.52

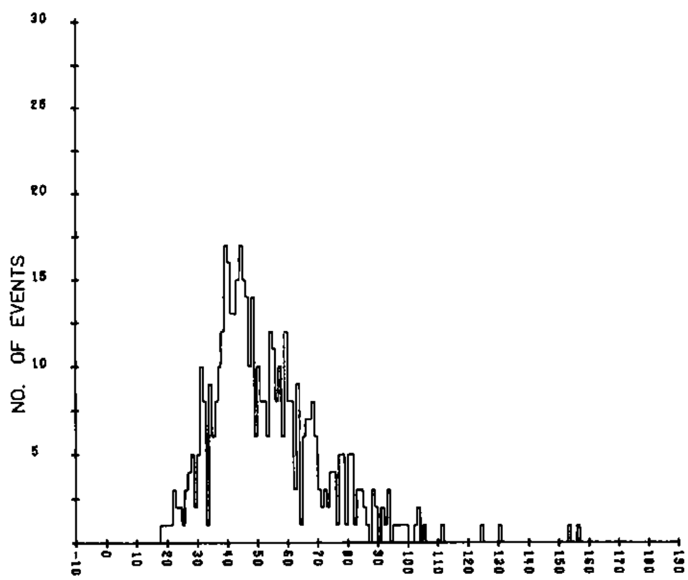


BI/K X 100 MEAN 21.73 ST DEV6.89



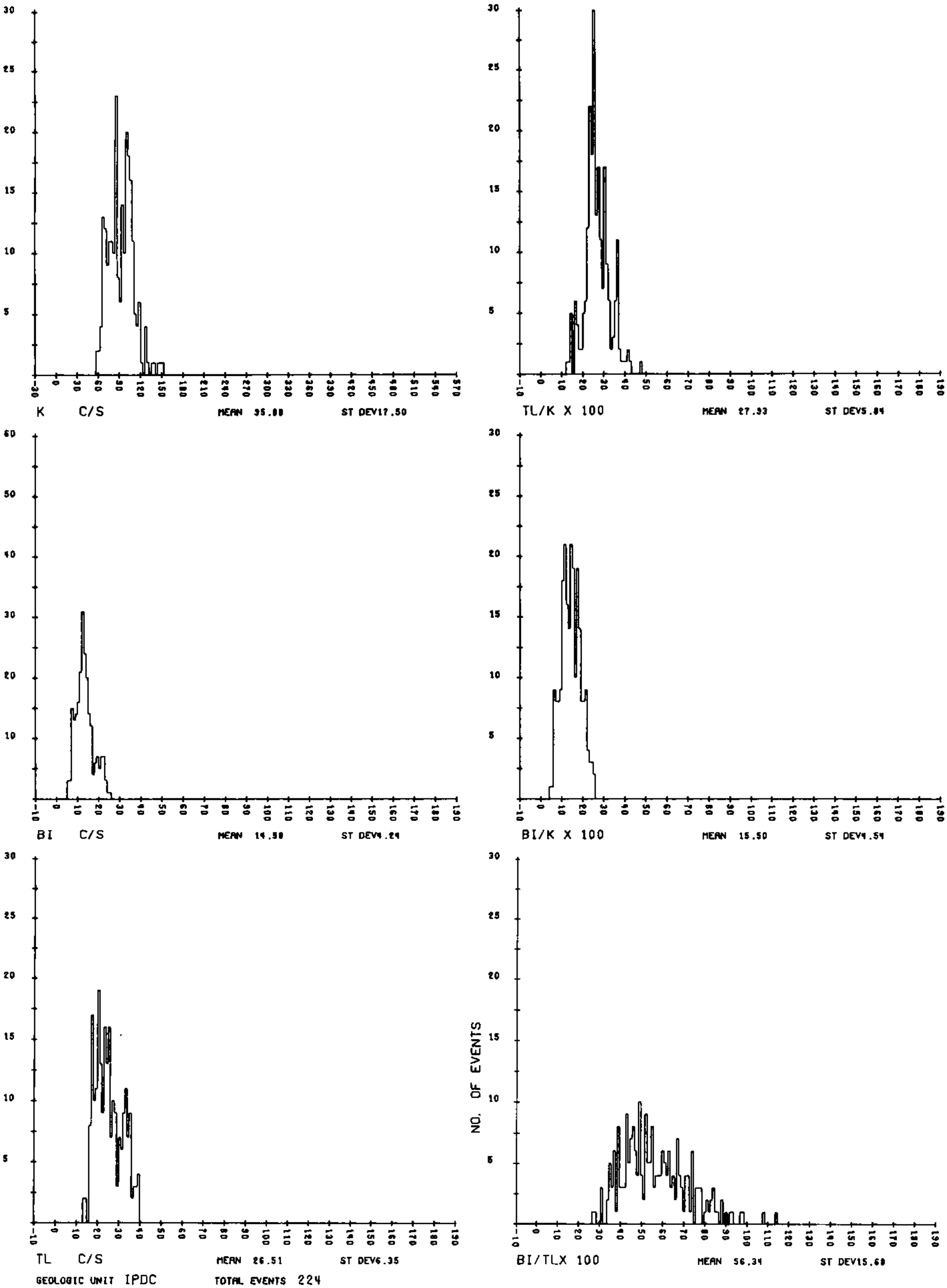
TL C/S MEAN 38.97 ST DEV16.20

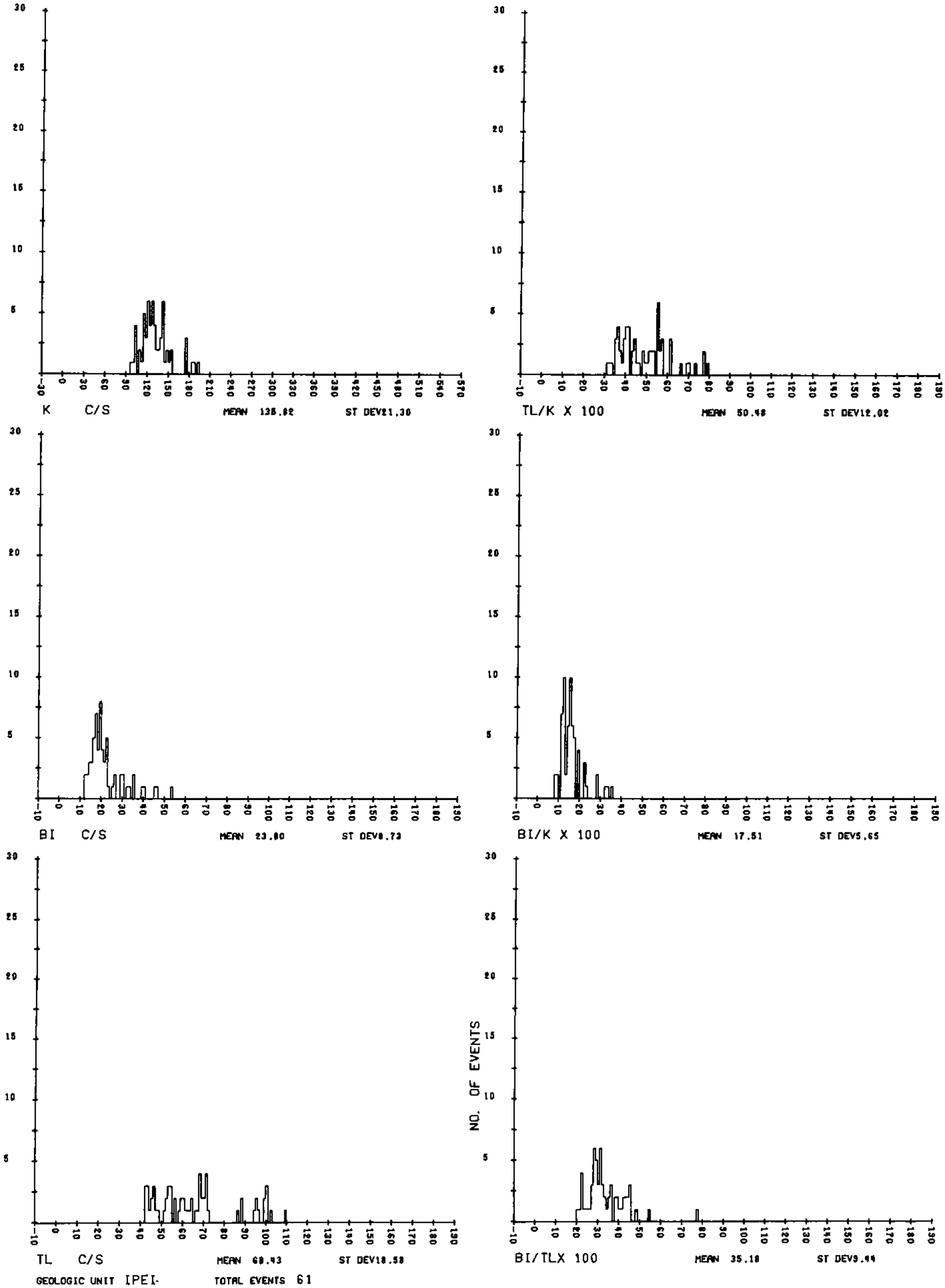
GEOLOGIC UNIT IPCR TOTAL EVENTS 473



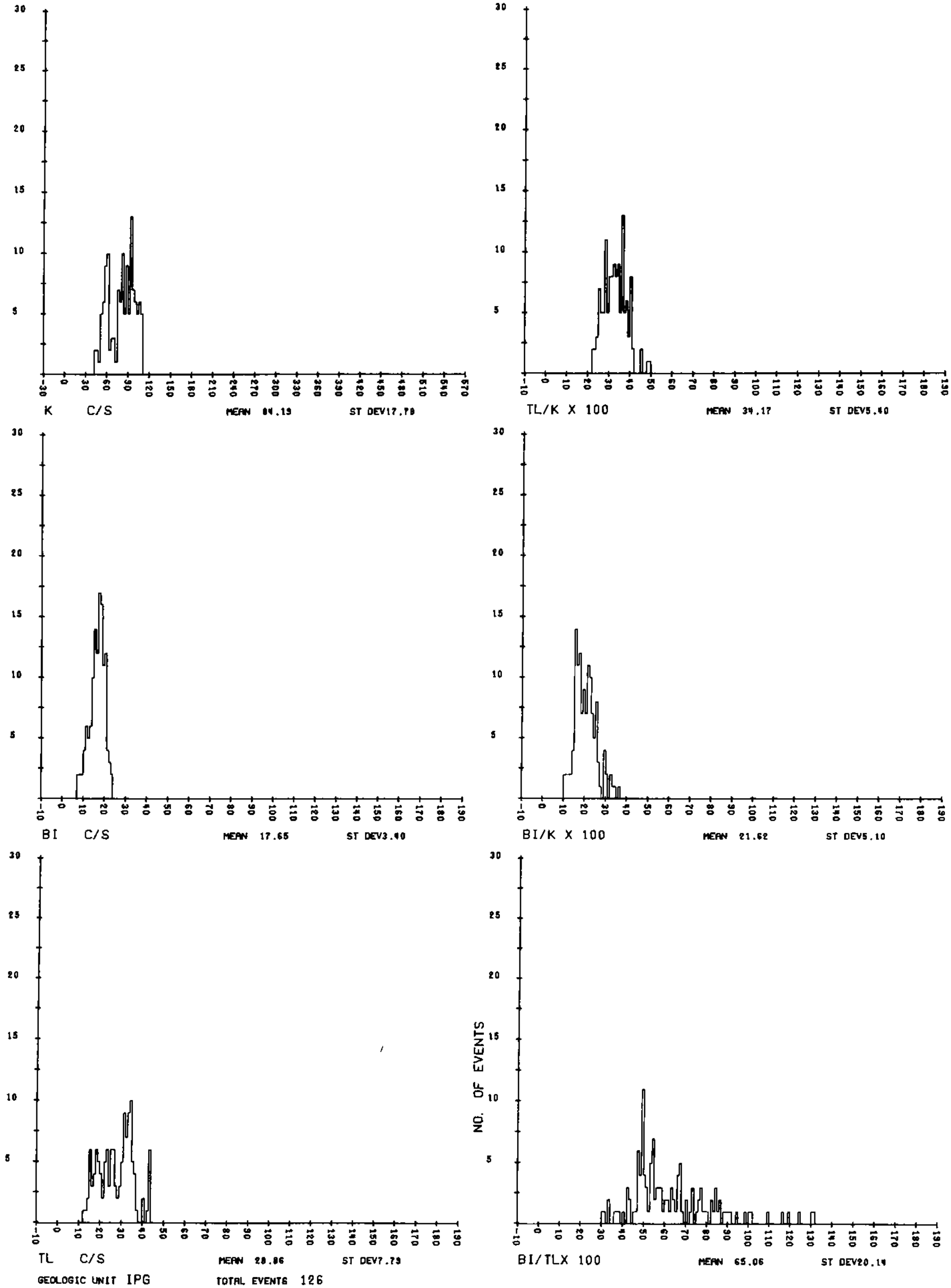
BI/TLX 100 MEAN 54.39 ST DEV19.04

A 15 BRIGHAM CITY

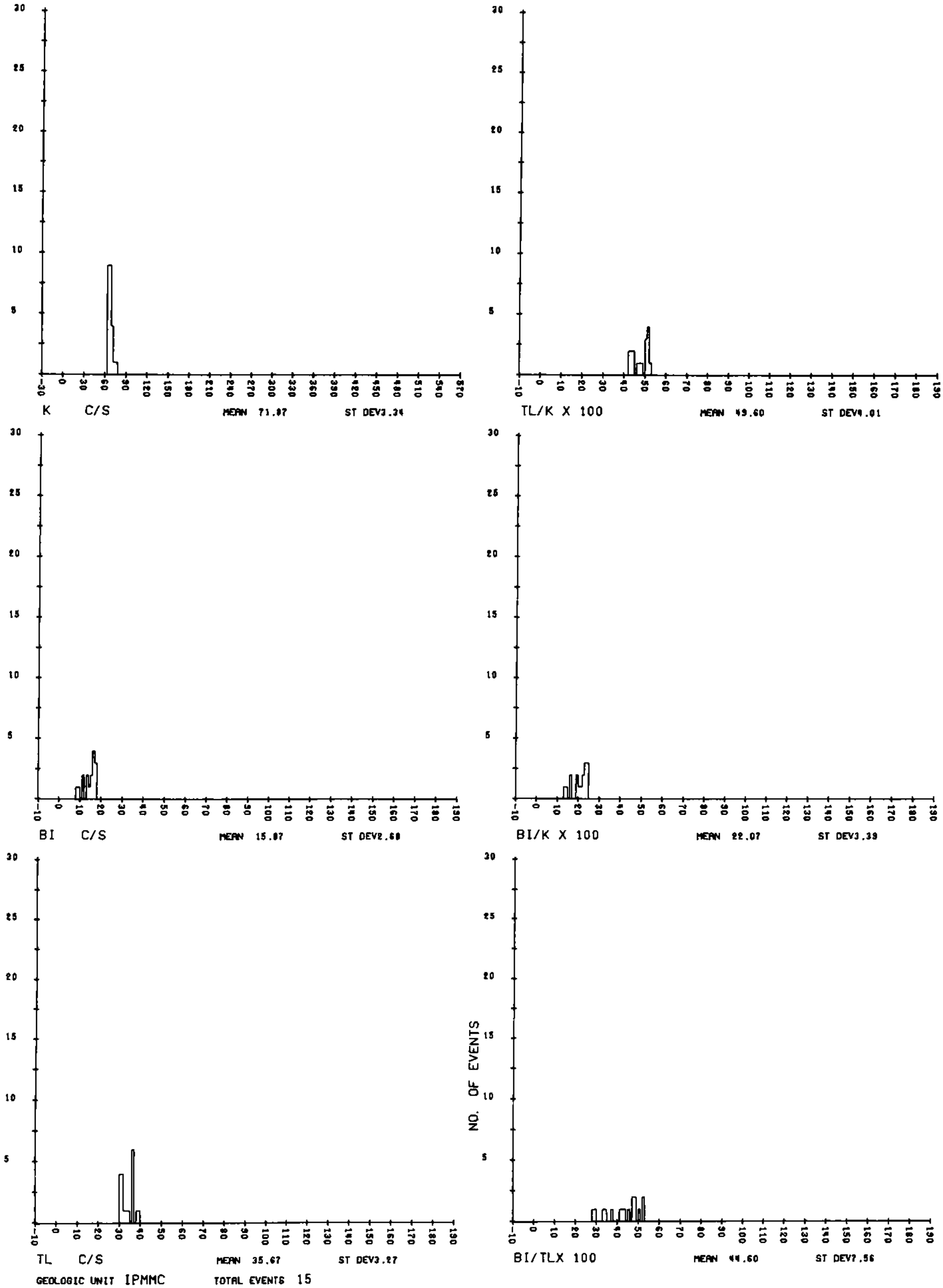

K C/S
MEAN 35.88
ST DEV17.50
TL/K X 100
MEAN 27.33
ST DEV5.84
BI C/S
MEAN 14.58
ST DEV4.24
BI/K X 100
MEAN 15.50
ST DEV4.54
TL C/S
MEAN 26.51
ST DEV6.35
GEOLOGIC UNIT IPDC
TOTAL EVENTS 224
NO. OF EVENTS
BI/TLX 100
MEAN 56.34
ST DEV15.68



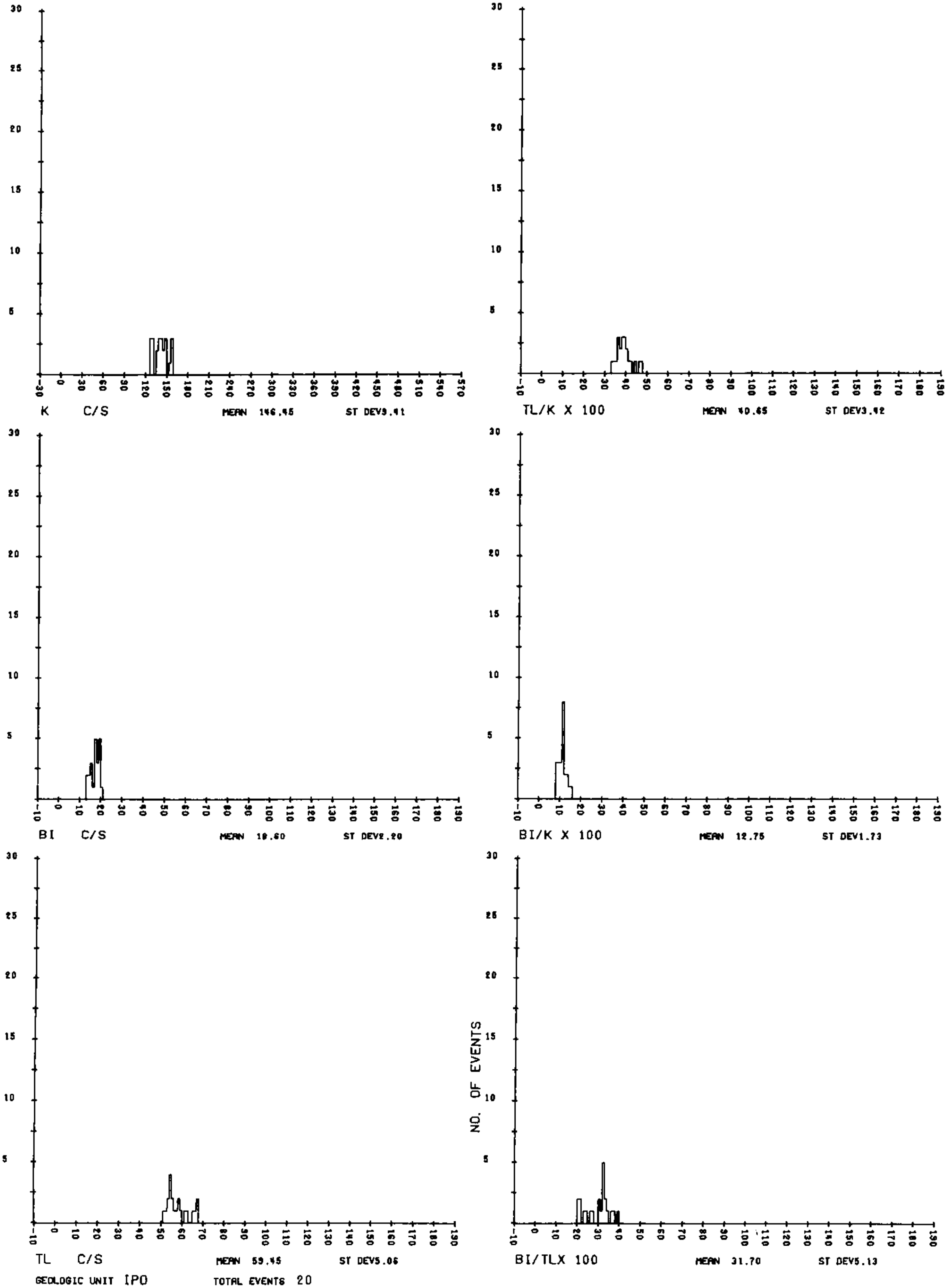
A 17 BRIGHAM CITY



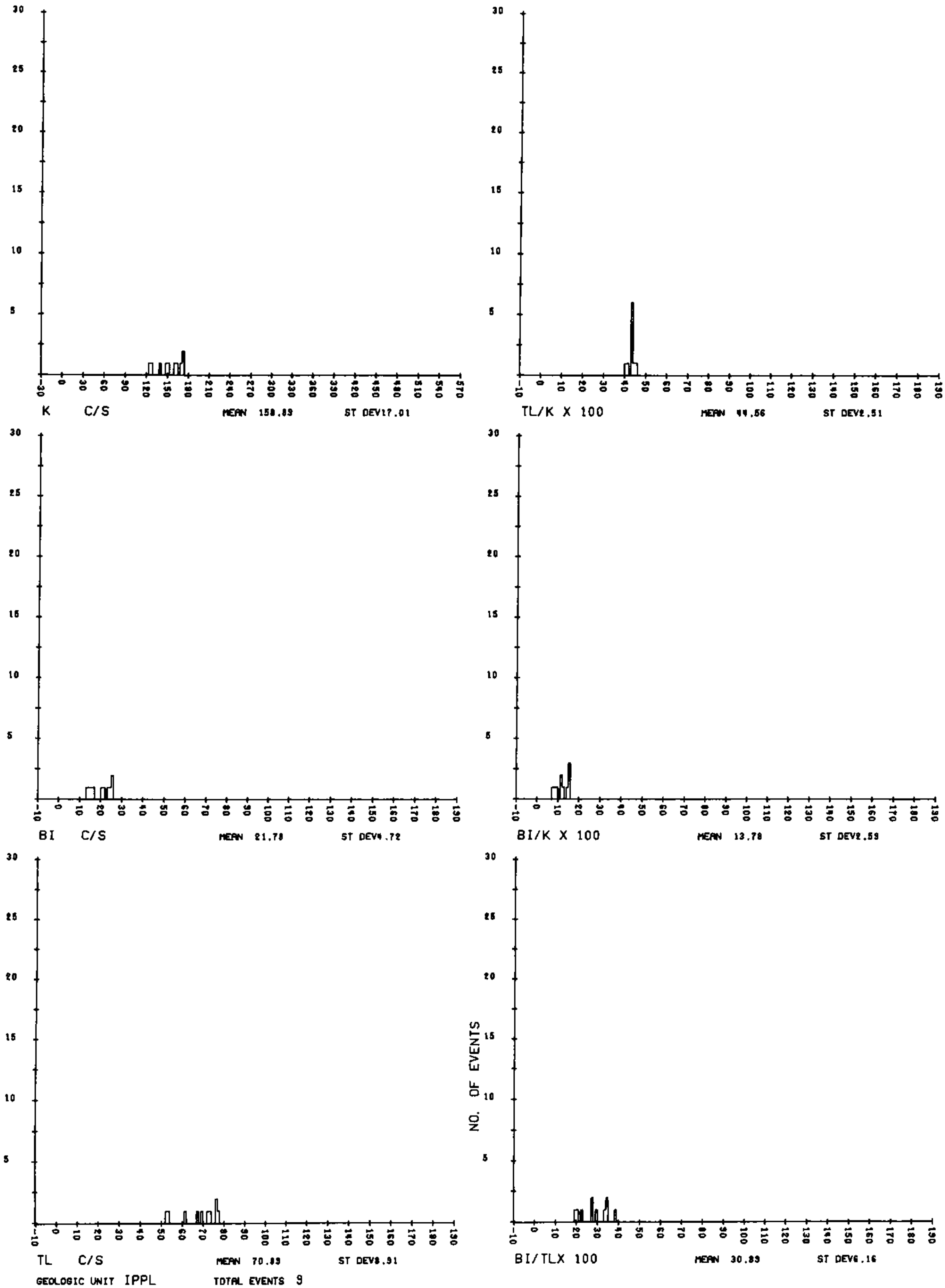
A 18 BRIGHAM CITY



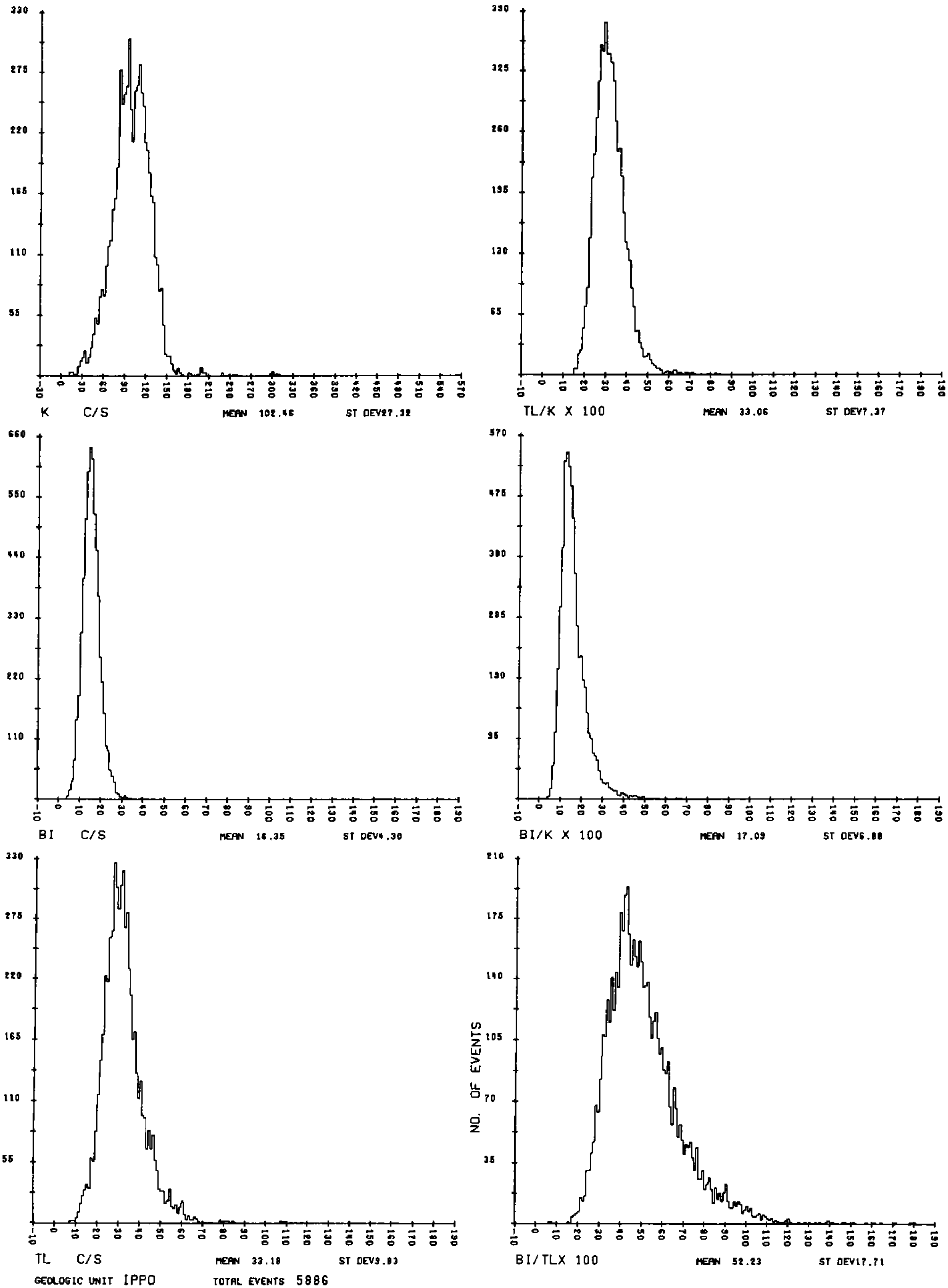
A 19 BRIGHAM CITY



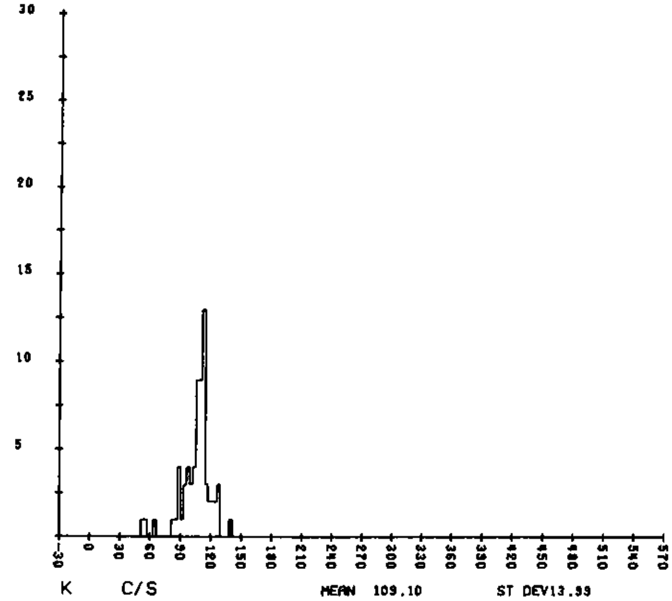
A20 BRIGHAM CITY

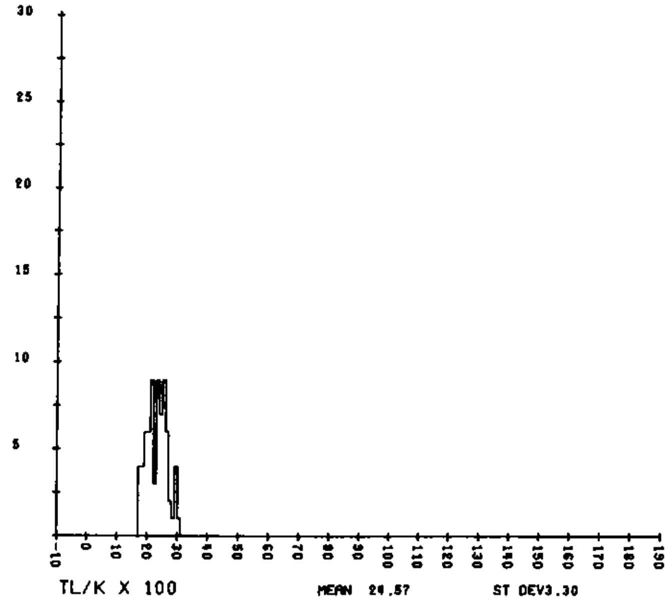


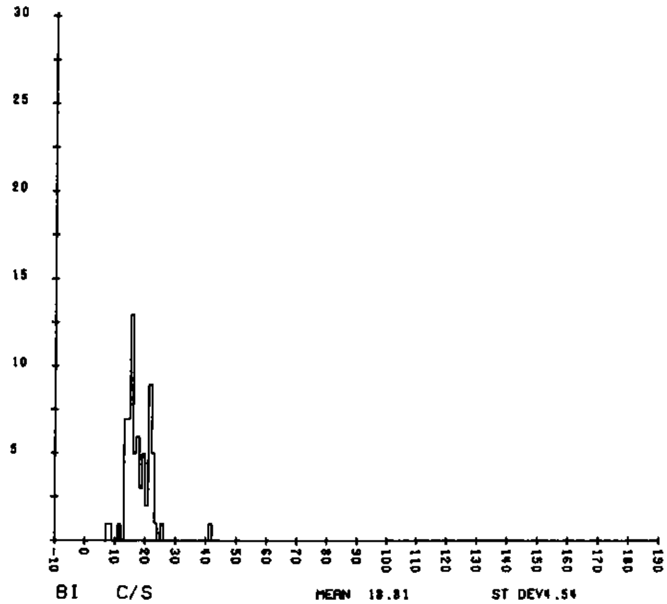
A 21 BRIGHAM CITY

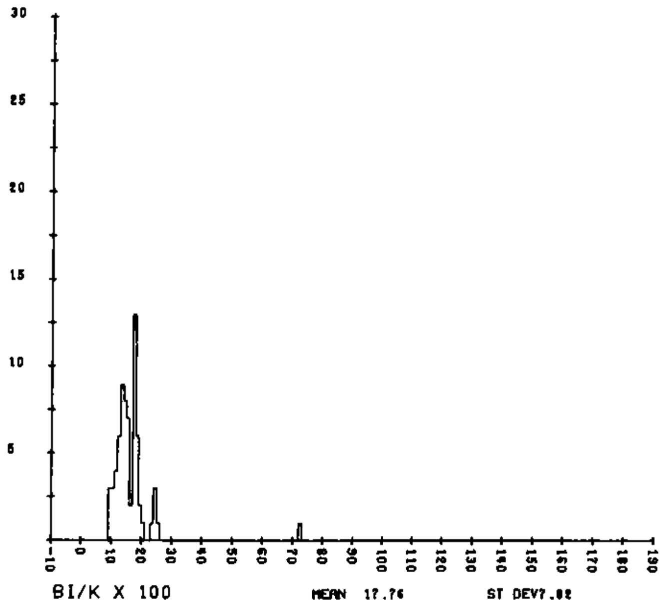


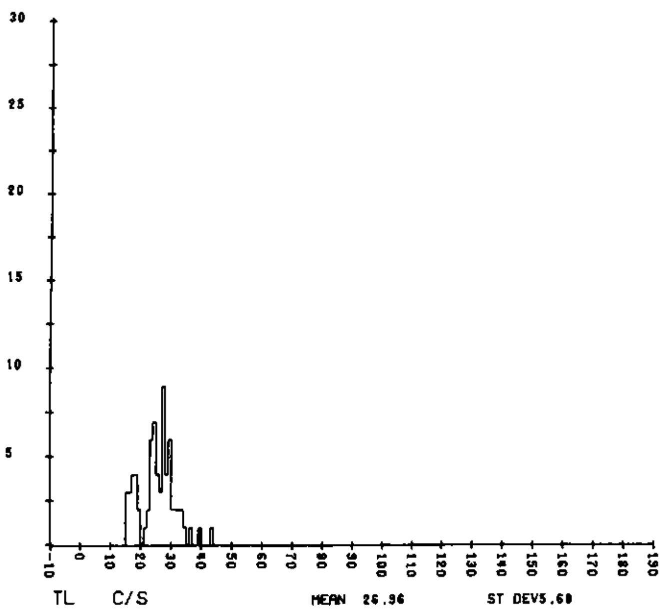
A 22 BRIGHAM CITY

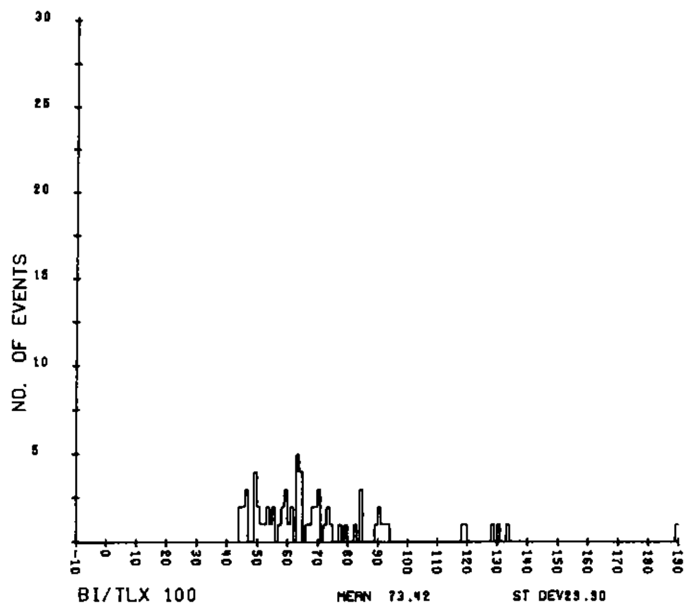






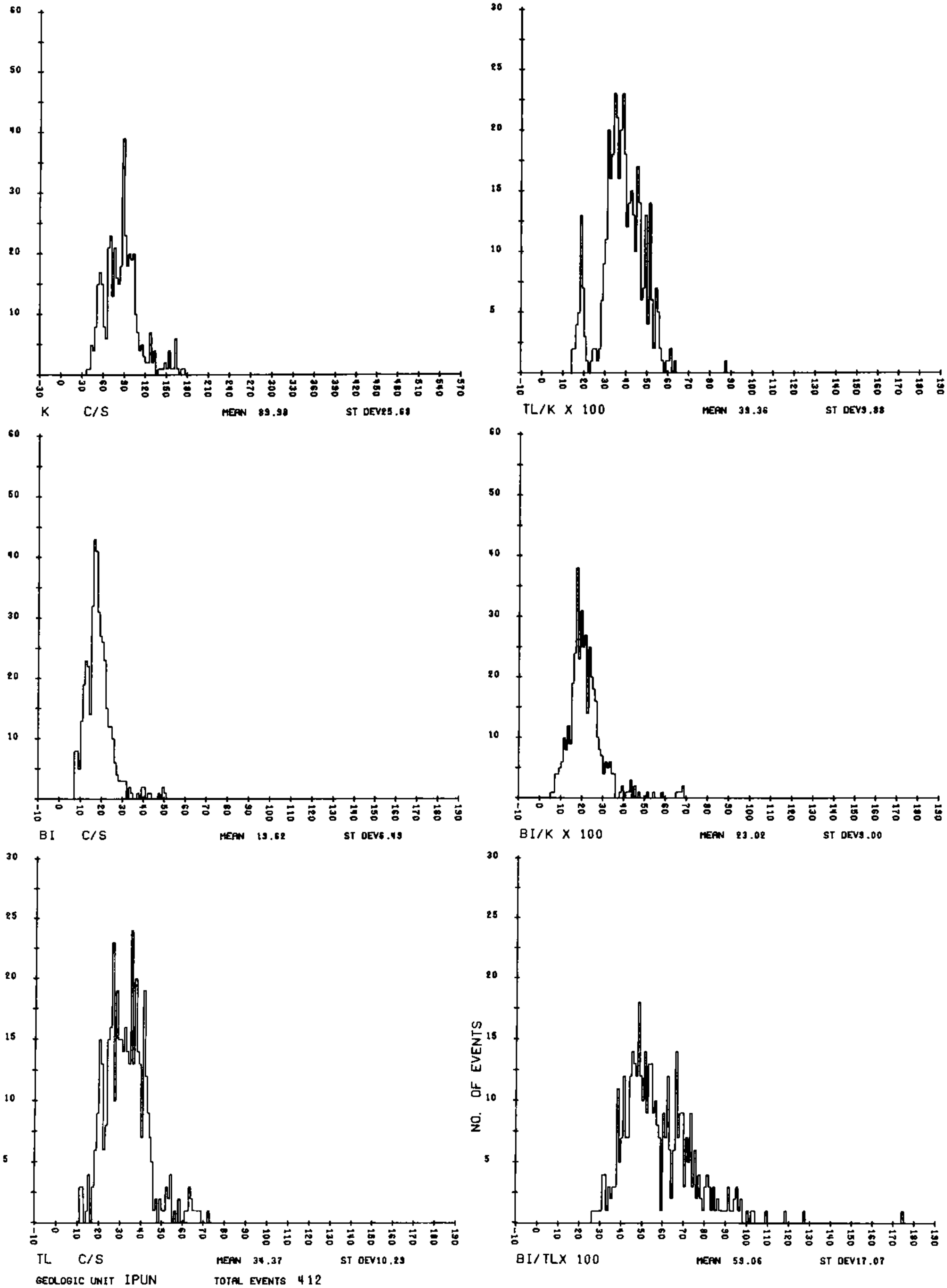




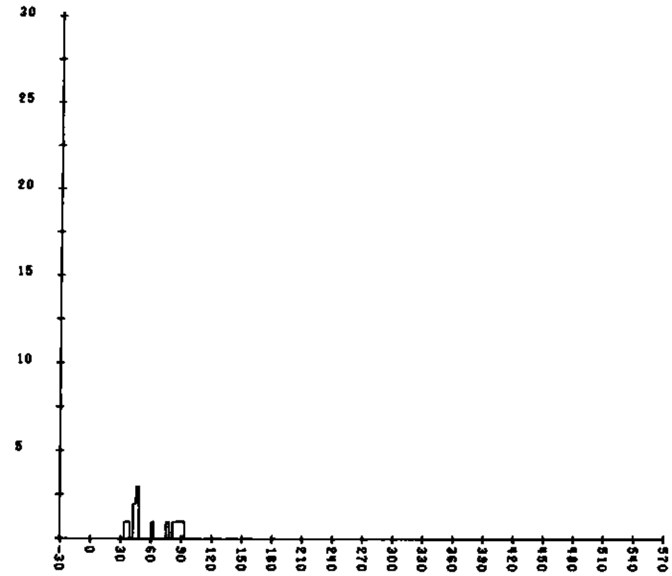


GEOLOGIC UNIT IPPU TOTAL EVENTS 67

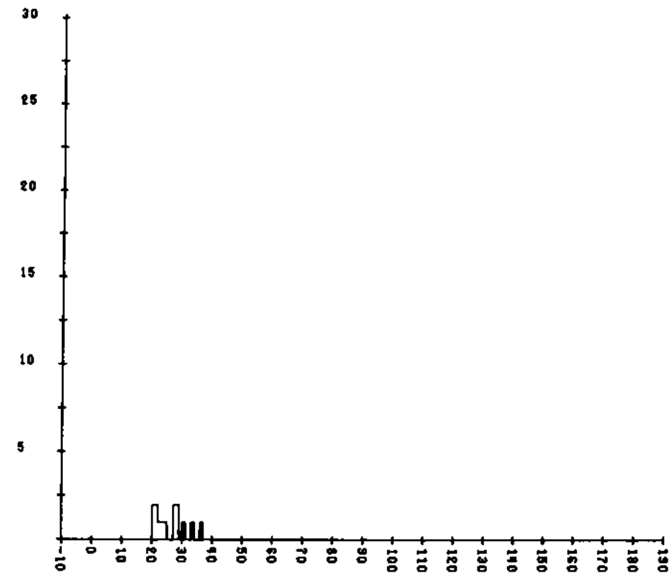
A23 BRIGHAM CITY



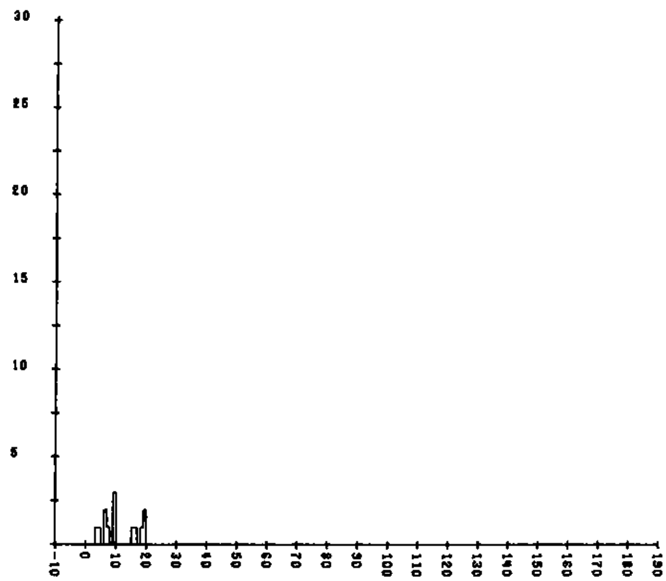
A24 BRIGHAM CITY



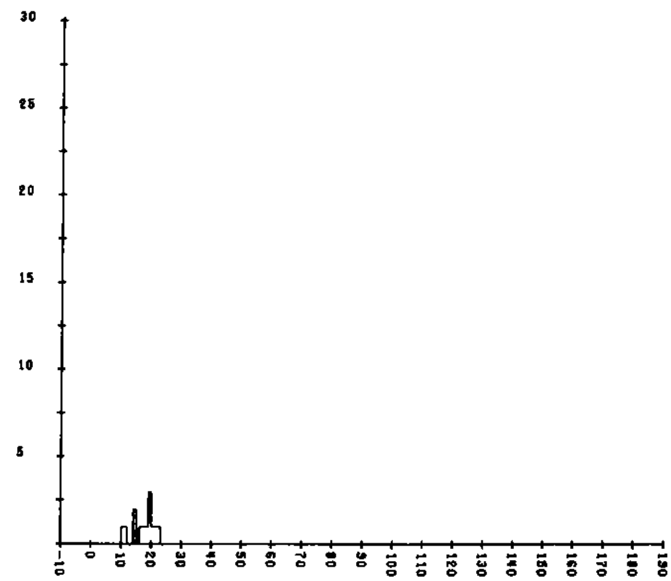
K C/S MEAN 65.67 ST DEV21.22



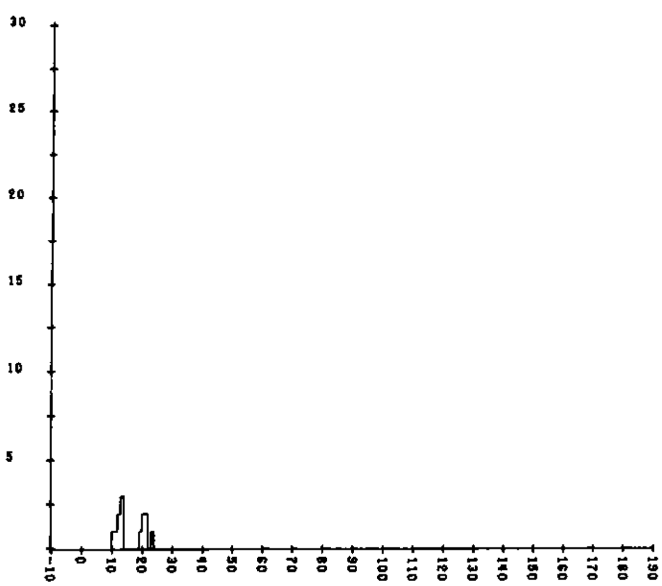
TL/K X 100 MEAN 28.00 ST DEV5.39



BI C/S MEAN 12.83 ST DEV5.58

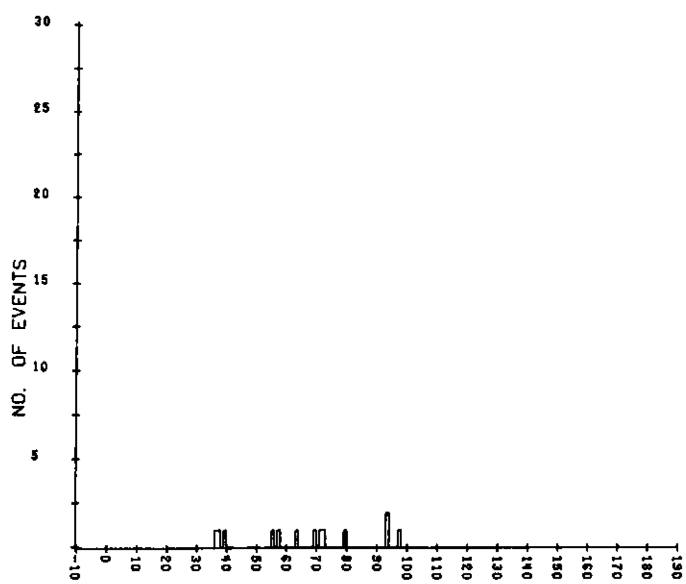


BI/K X 100 MEAN 19.32 ST DEV3.32

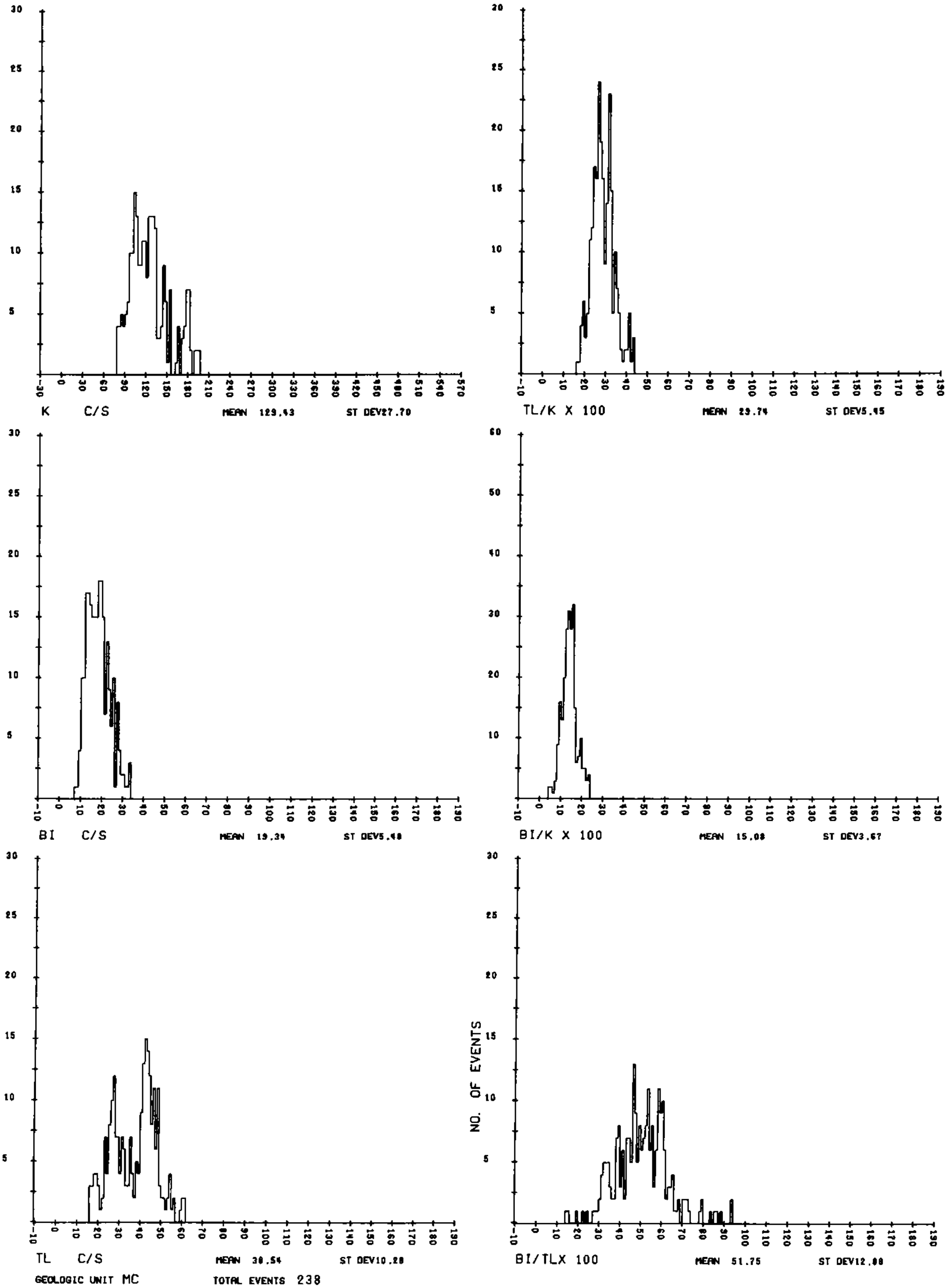


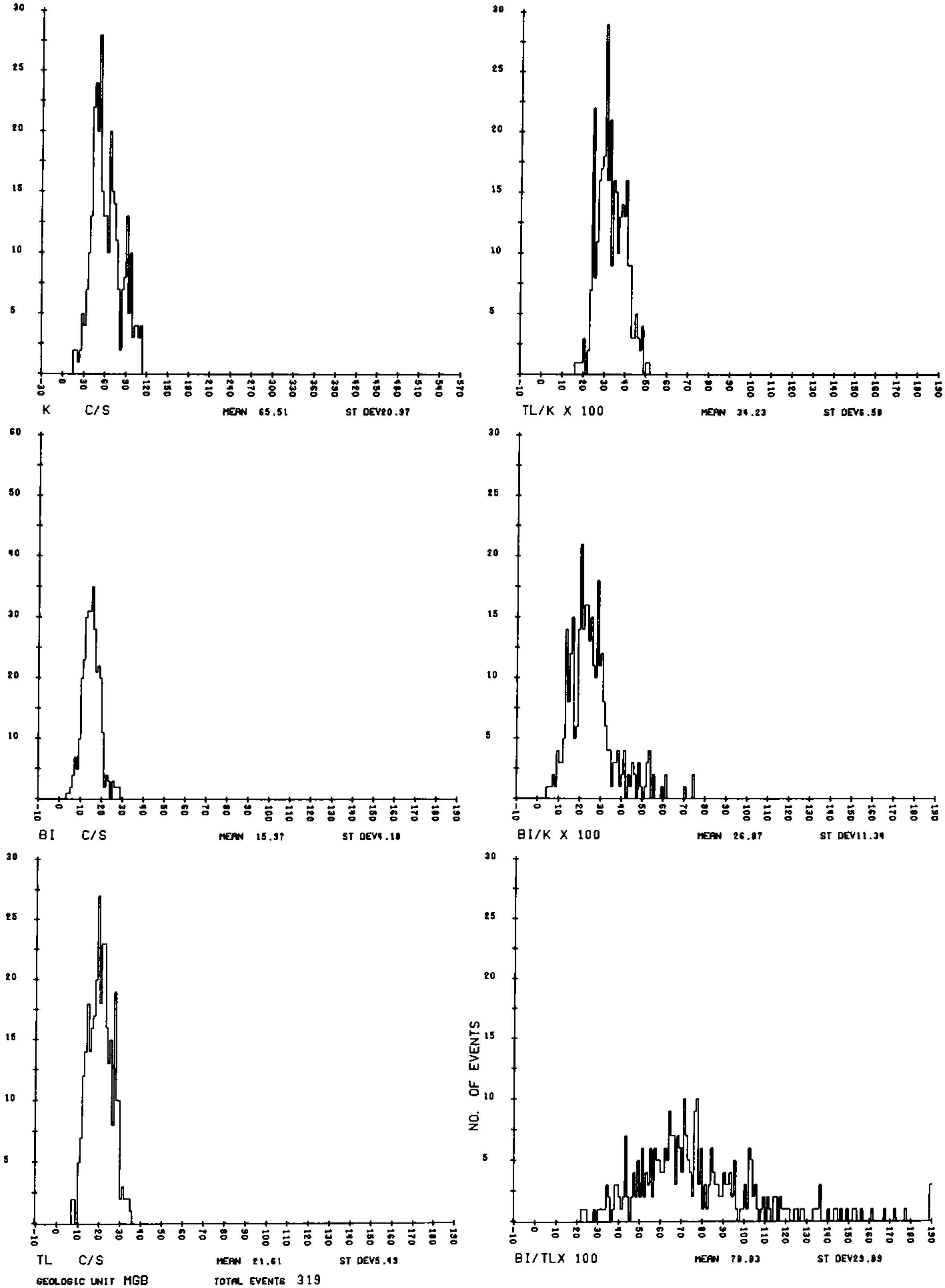
TL C/S MEAN 17.83 ST DEV4.30

GEOLOGIC UNIT MB TOTAL EVENTS 12

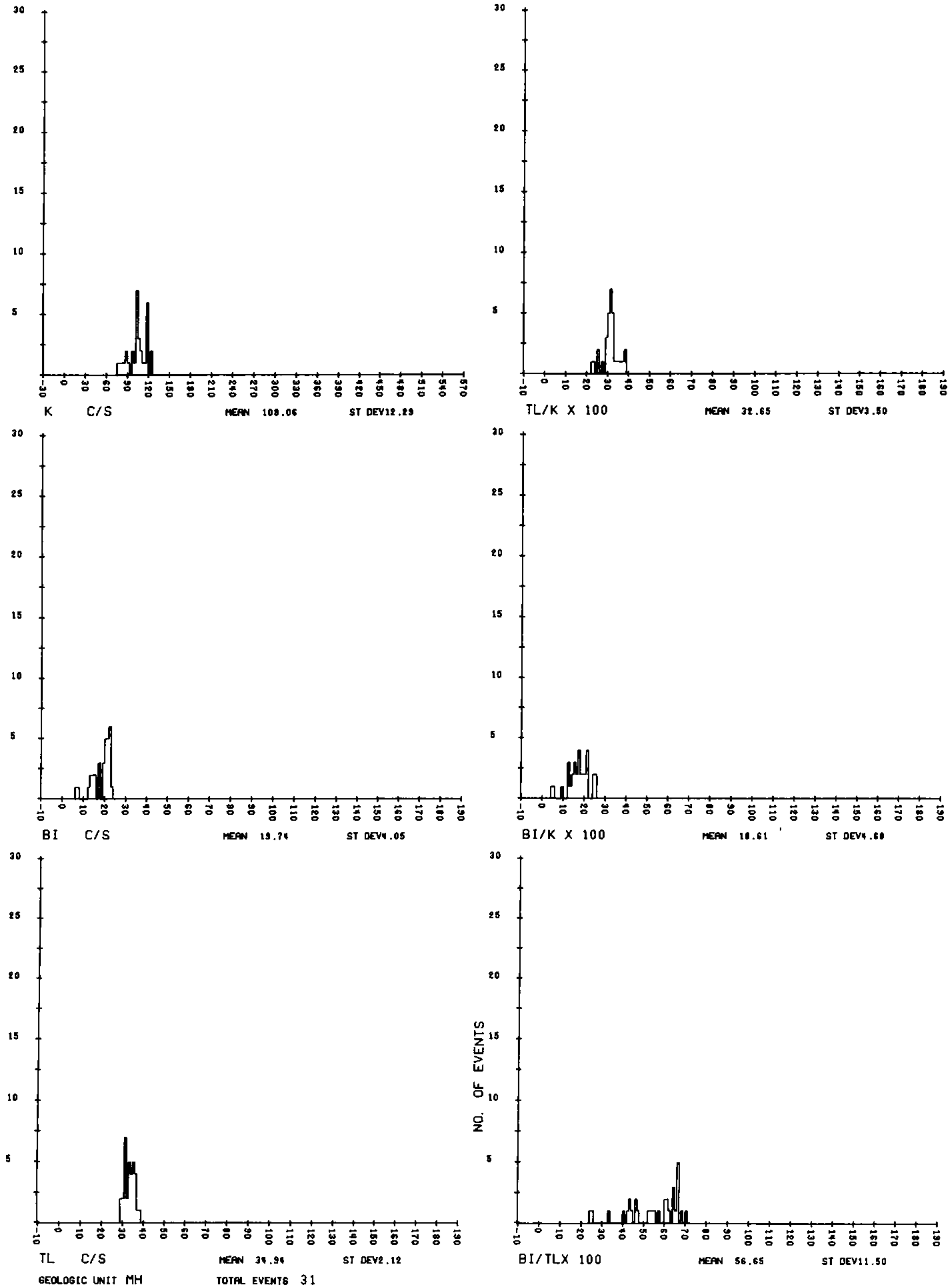


BI/TLX 100 MEAN 70.17 ST DEV20.13

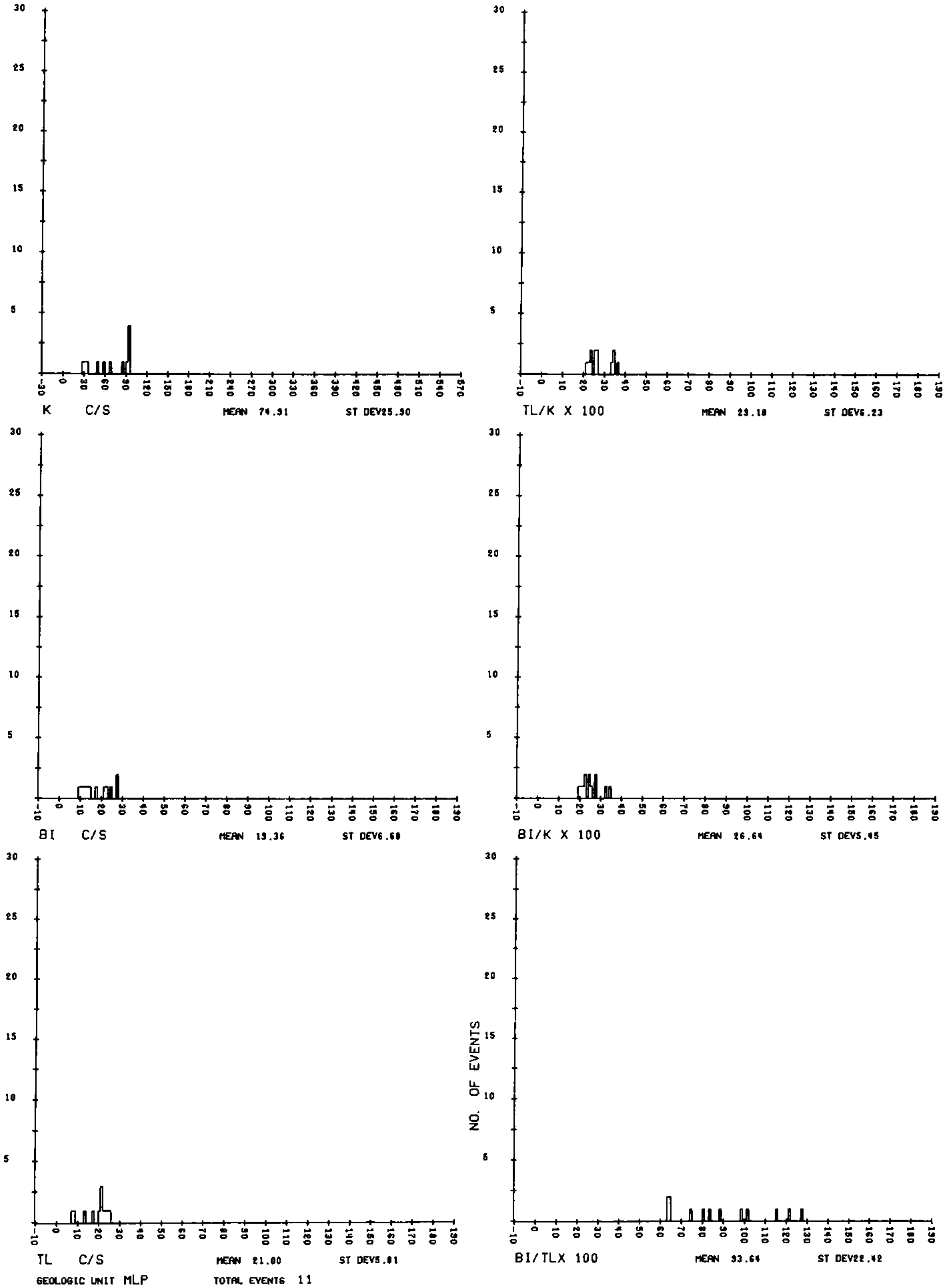

K C/S
MEAN 129.43
ST DEV27.70
TL/K X 100
MEAN 23.74
ST DEV5.45
BI C/S
MEAN 19.34
ST DEV5.48
BI/K X 100
MEAN 15.08
ST DEV3.67
TL C/S
MEAN 38.54
ST DEV10.28
BI/TLX 100
MEAN 51.75
ST DEV12.88
NO. OF EVENTS
GEOLOGIC UNIT MC
TOTAL EVENTS 238



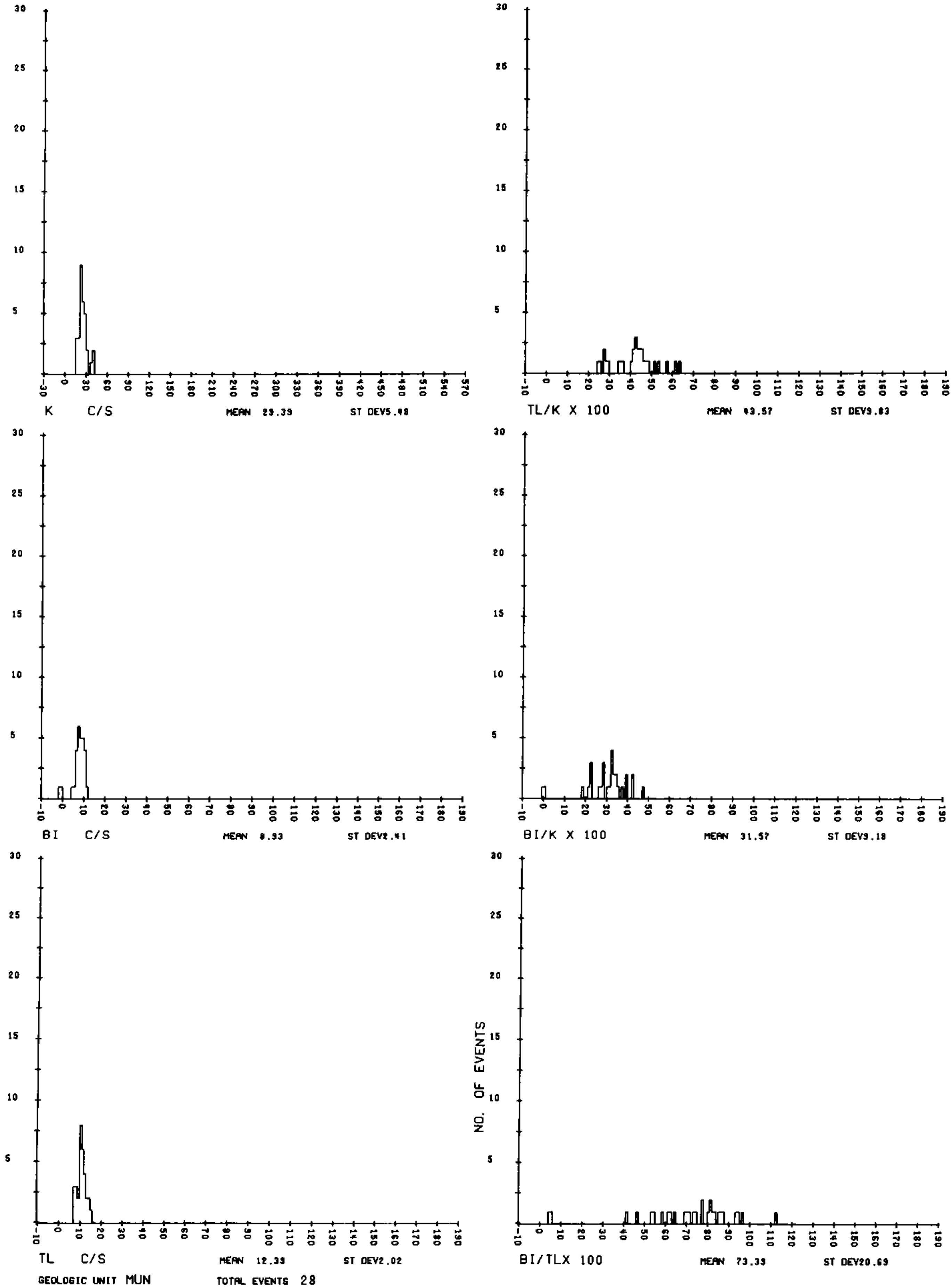
A 27 BRIGHAM CITY



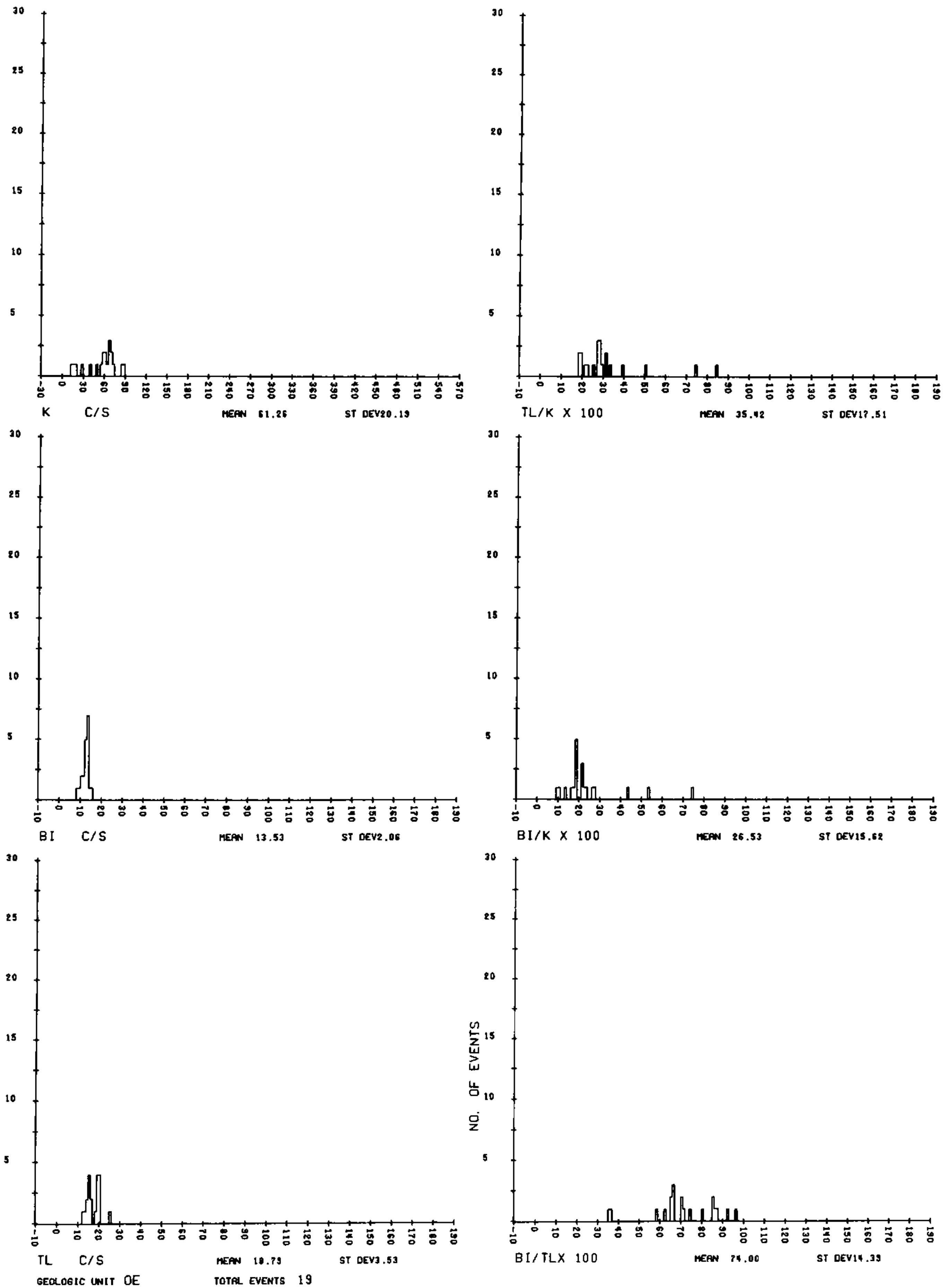
A 28 BRIGHAM CITY



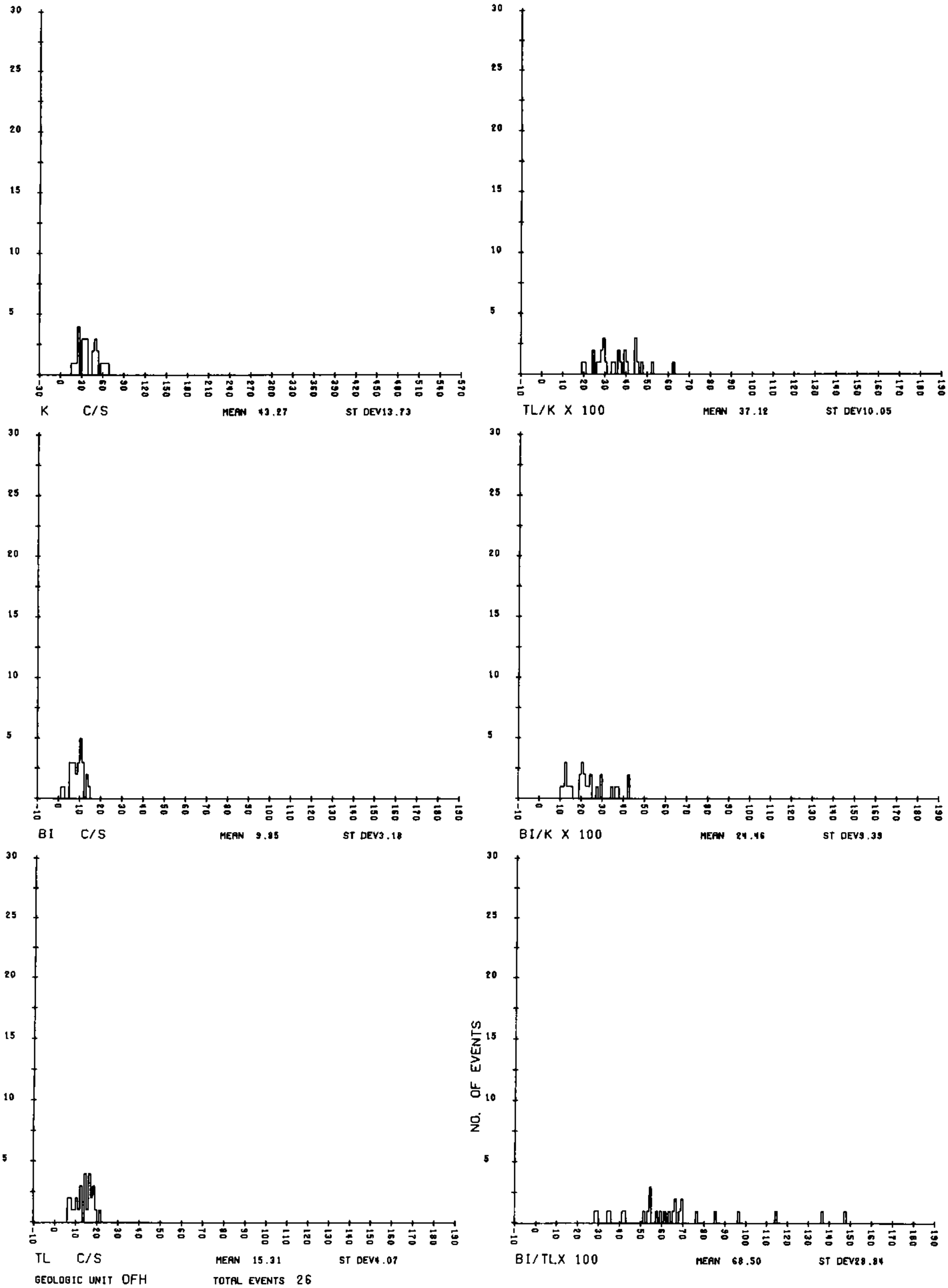
A29 BRIGHAM CITY



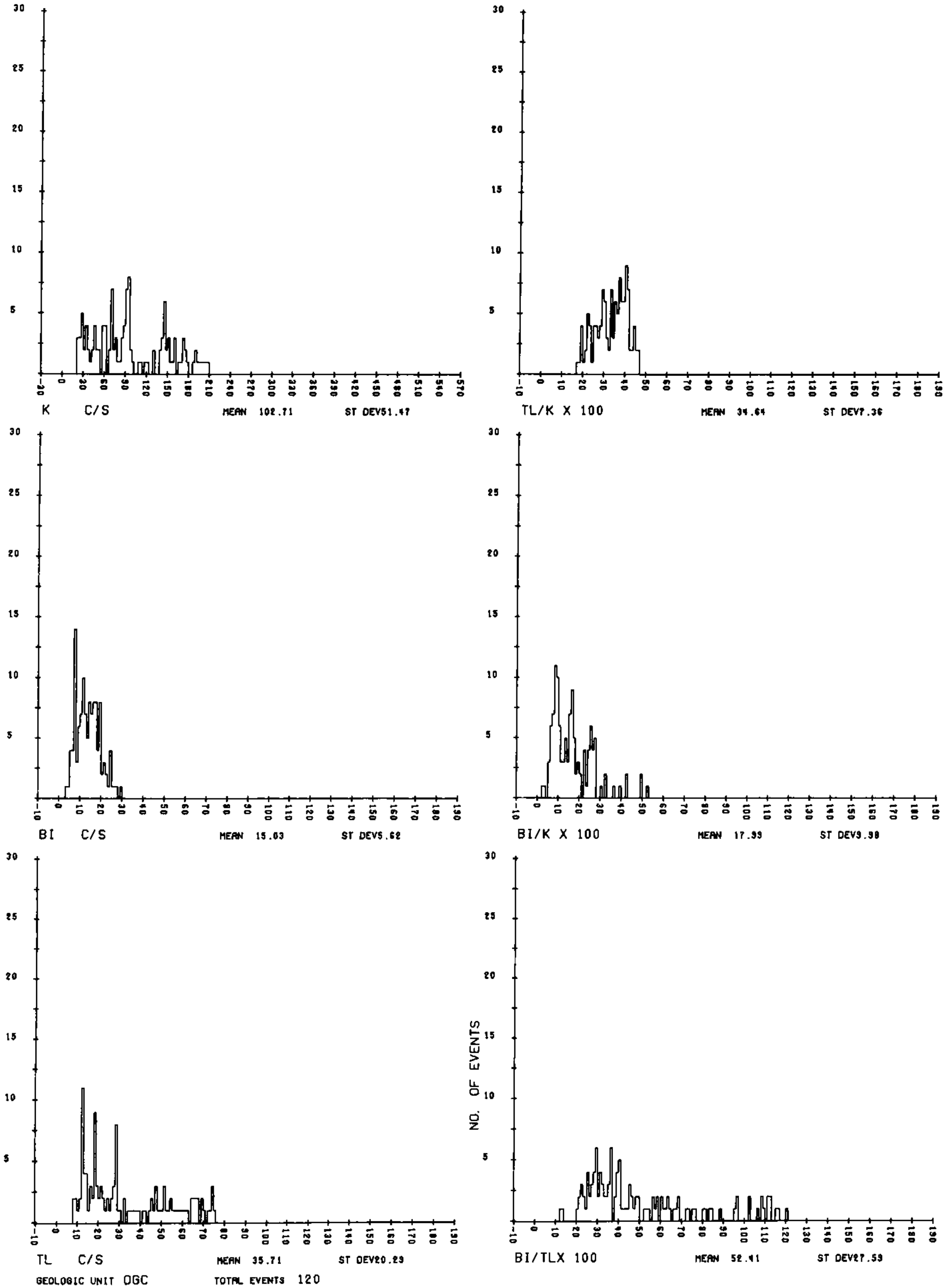
A 30 BRIGHAM CITY

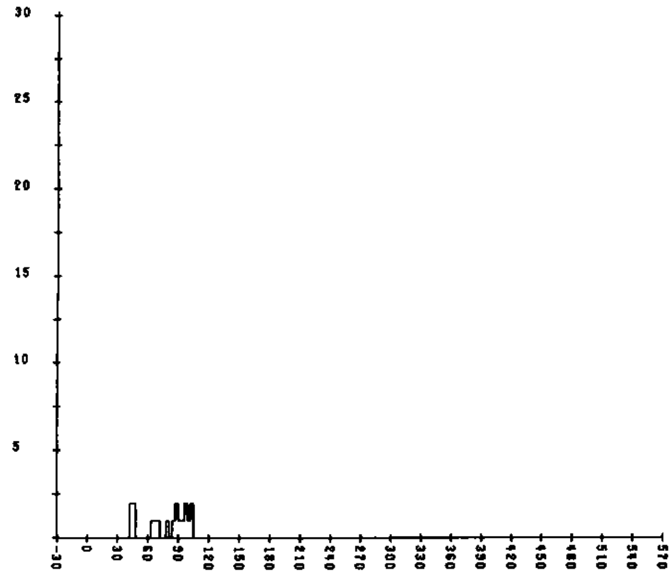


A 31 BRIGHAM CITY

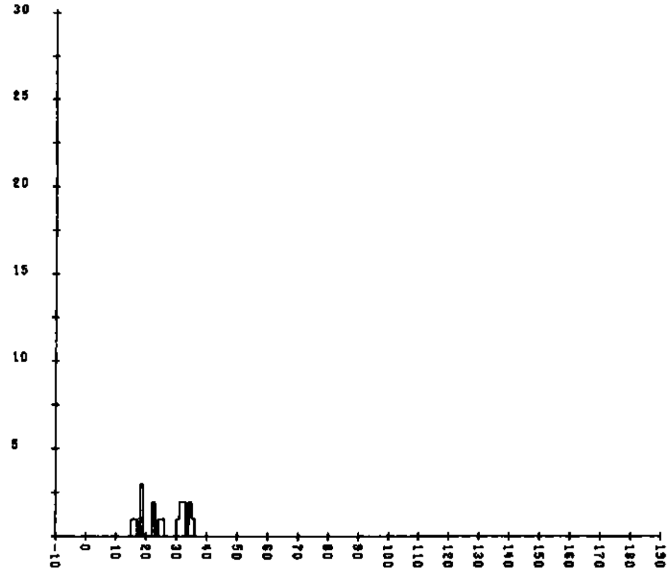


A 32 BRIGHAM CITY

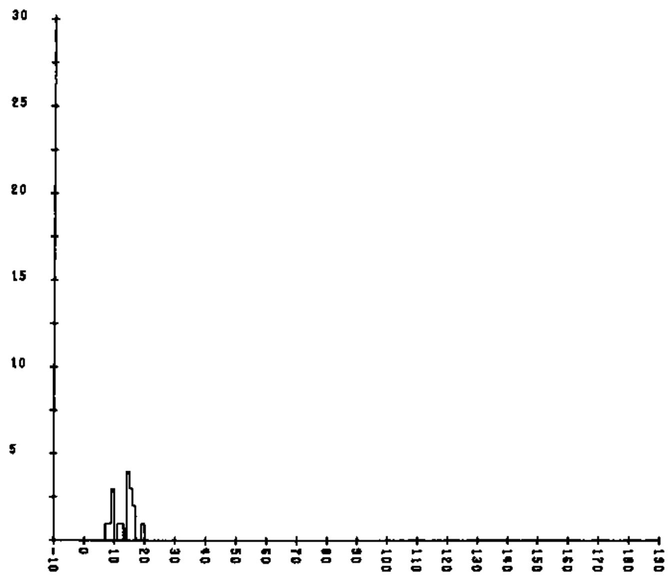

K C/S
MEAN 102.71
ST DEV51.47
TL/K X 100
MEAN 34.64
ST DEV7.36
BI C/S
MEAN 15.03
ST DEV5.62
BI/K X 100
MEAN 17.39
ST DEV9.38
TL C/S
MEAN 35.71
ST DEV20.29
GEOLOGIC UNIT OGC
TOTAL EVENTS 120
NO. OF EVENTS
BI/TLX 100
MEAN 52.41
ST DEV27.53



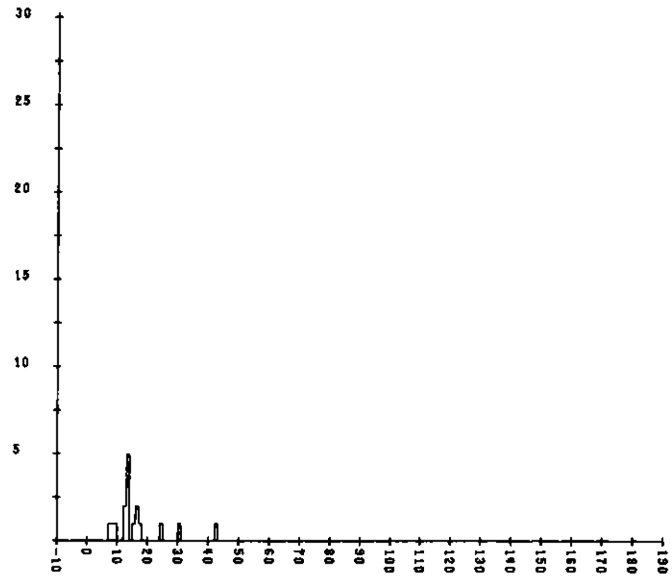
K C/S MEAN 86.06 ST DEV18.83



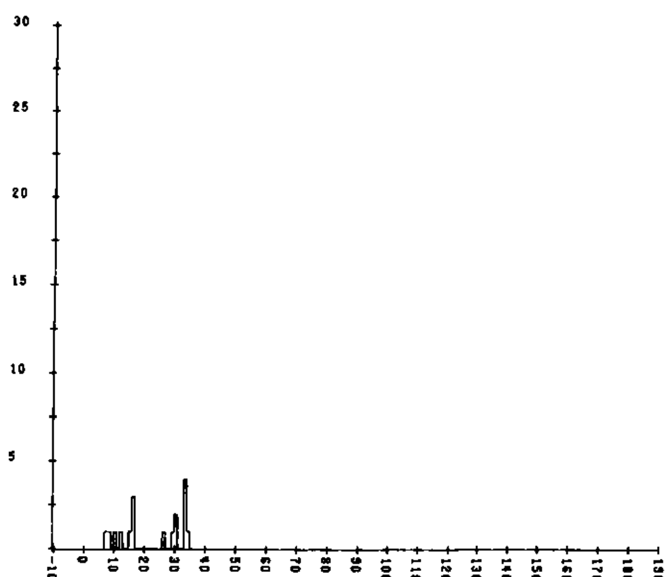
TL/K X 100 MEAN 27.81 ST DEV7.12



BI C/S MEAN 14.50 ST DEV3.41

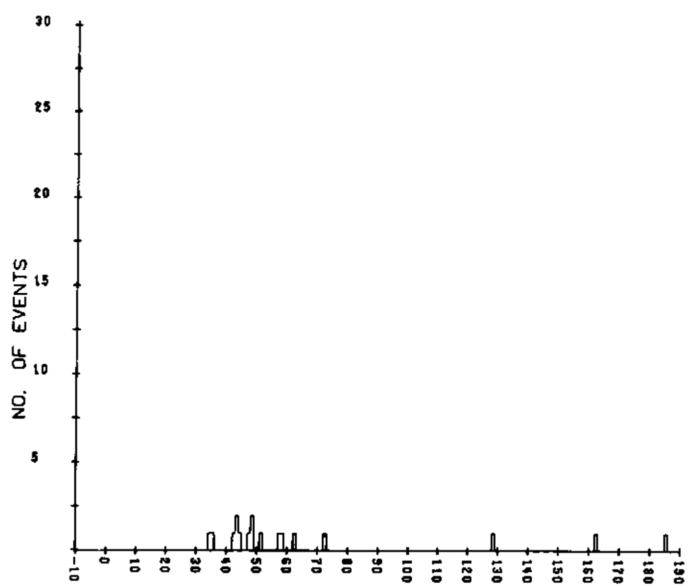


BI/K X 100 MEAN 18.25 ST DEV8.72

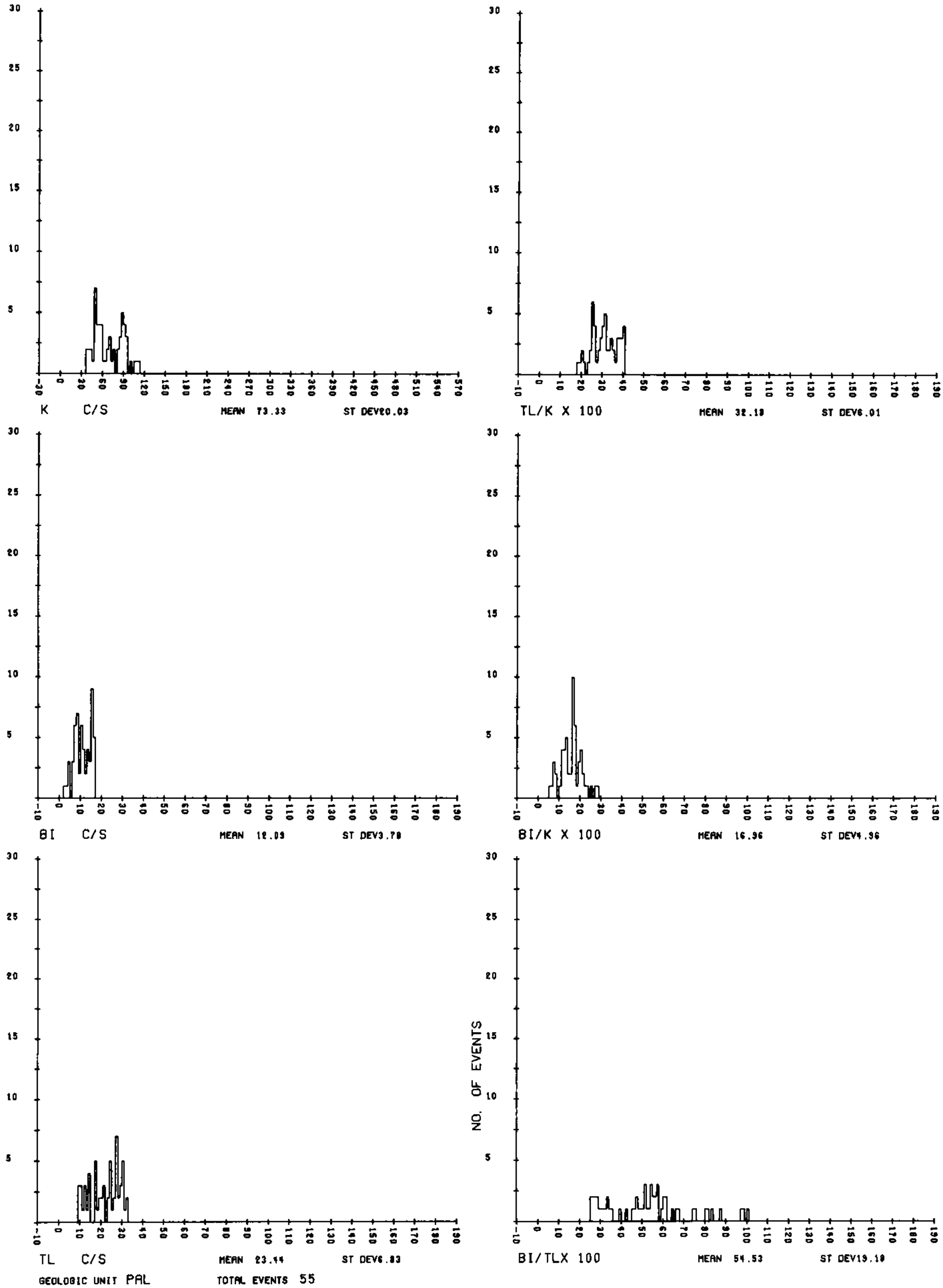


TL C/S MEAN 24.63 ST DEV3.63

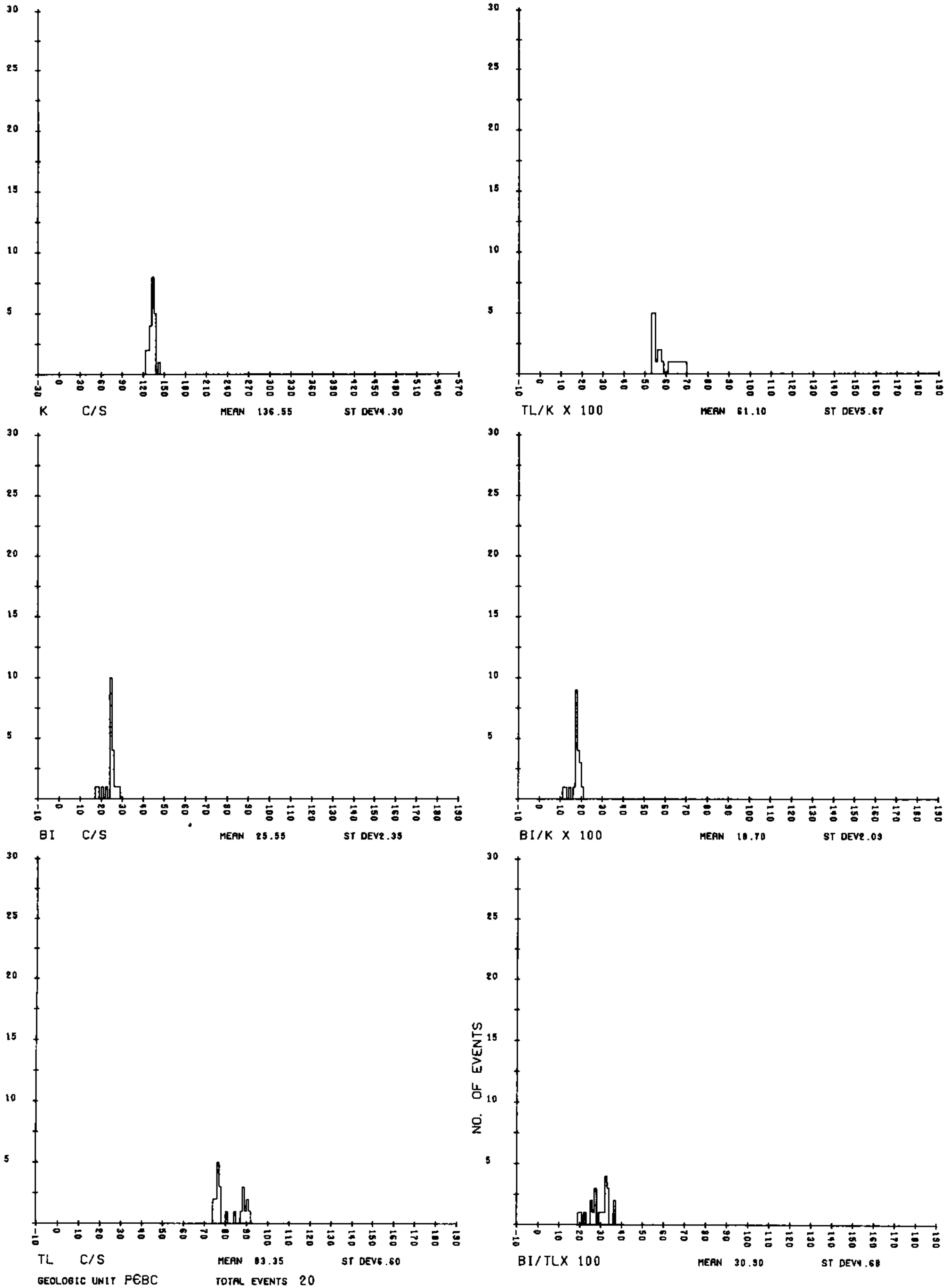
GEOLOGIC UNIT OSP TOTAL EVENTS 16



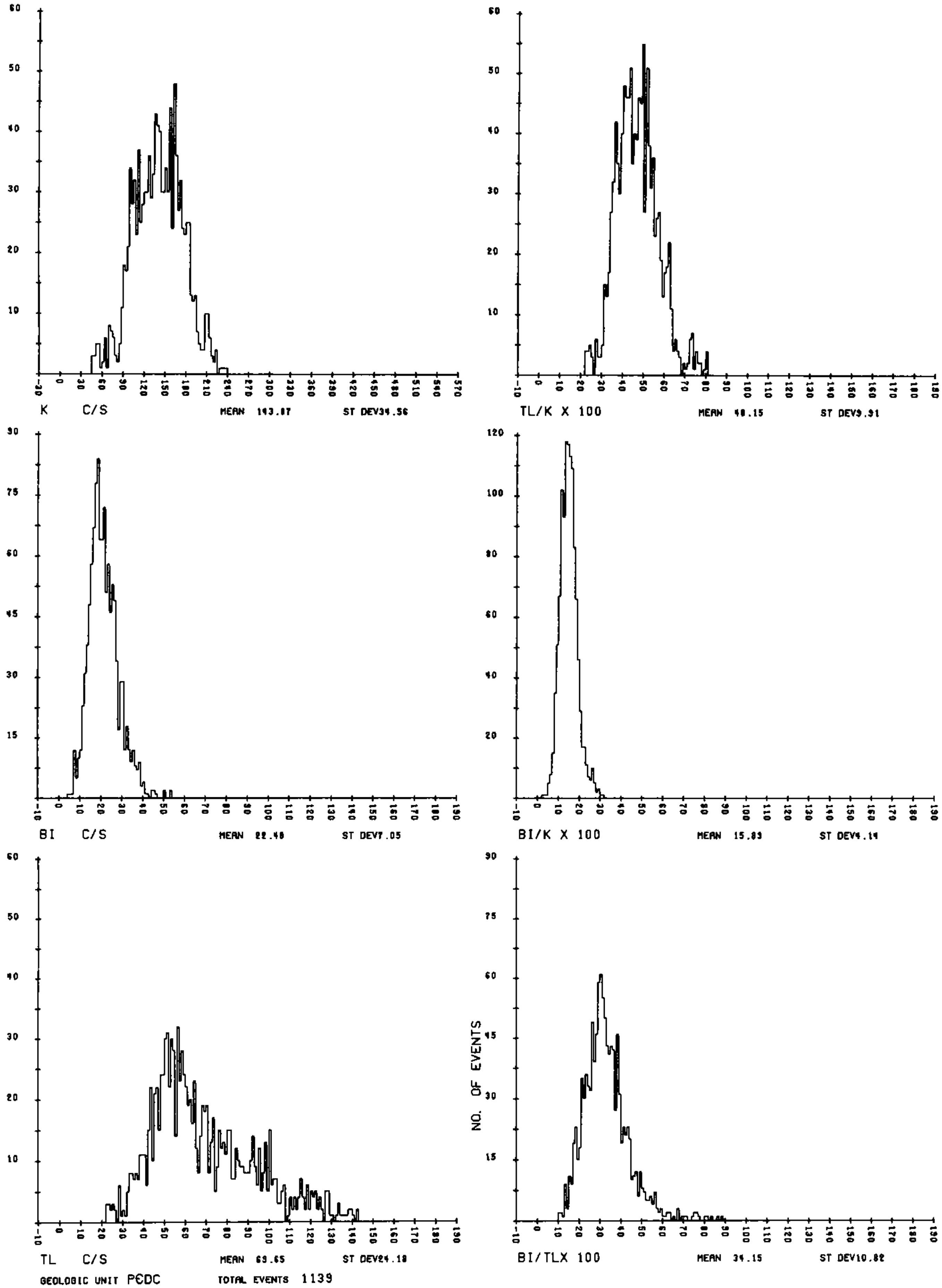
BI/TLX 100 MEAN 71.69 ST DEV45.95

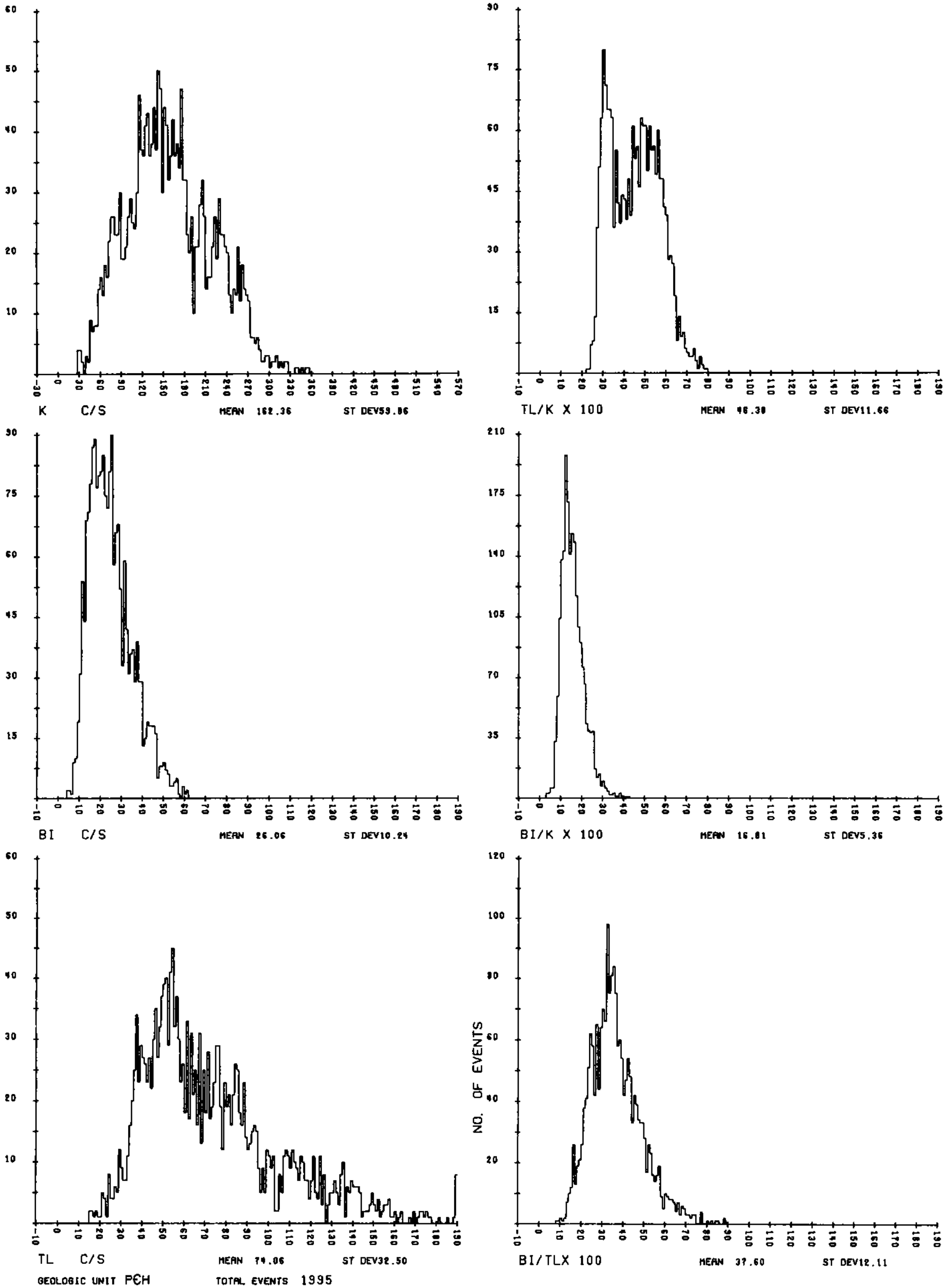


A 35 BRIGHAM CITY

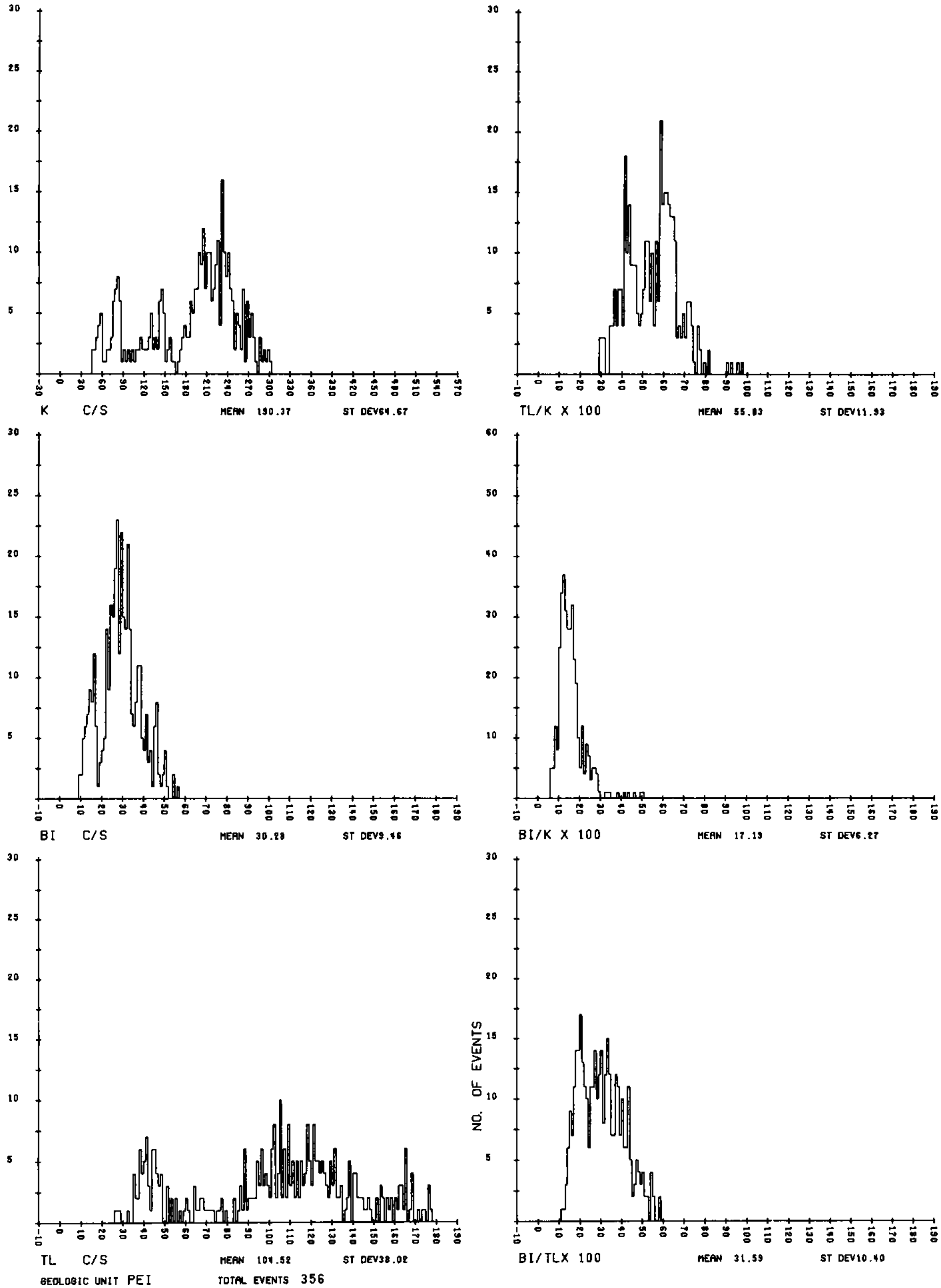


A 36 BRIGHAM CITY

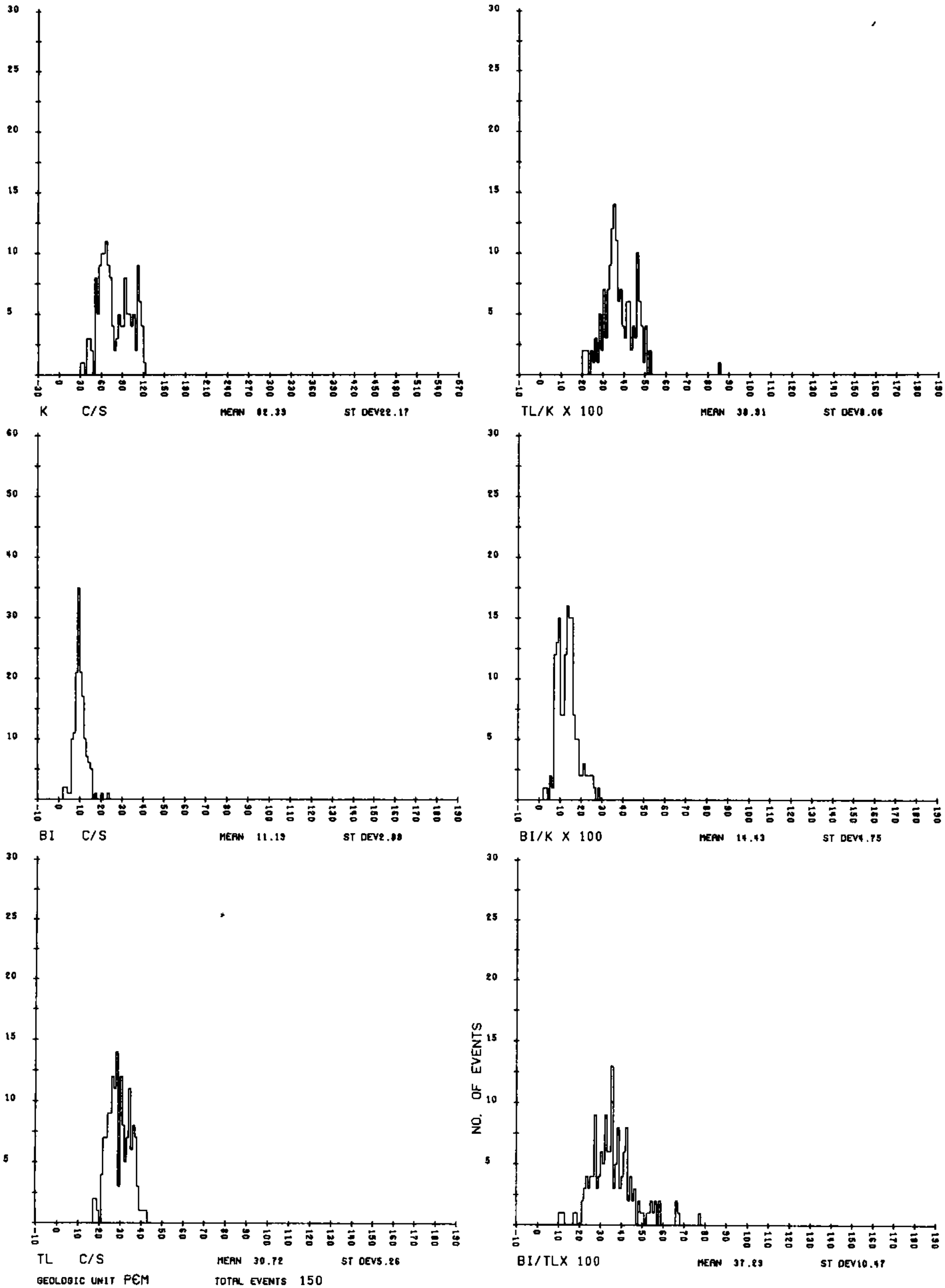

K C/S
MEAN 143.87
ST DEV34.56
TL/K X 100
MEAN 48.15
ST DEV9.91
BI C/S
MEAN 22.48
ST DEV7.05
BI/K X 100
MEAN 15.83
ST DEV4.14
NO. OF EVENTS
TL C/S
MEAN 69.65
ST DEV24.18
BI/TLX 100
MEAN 34.15
ST DEV10.82
GEOLOGIC UNIT PЄDC
TOTAL EVENTS 1139



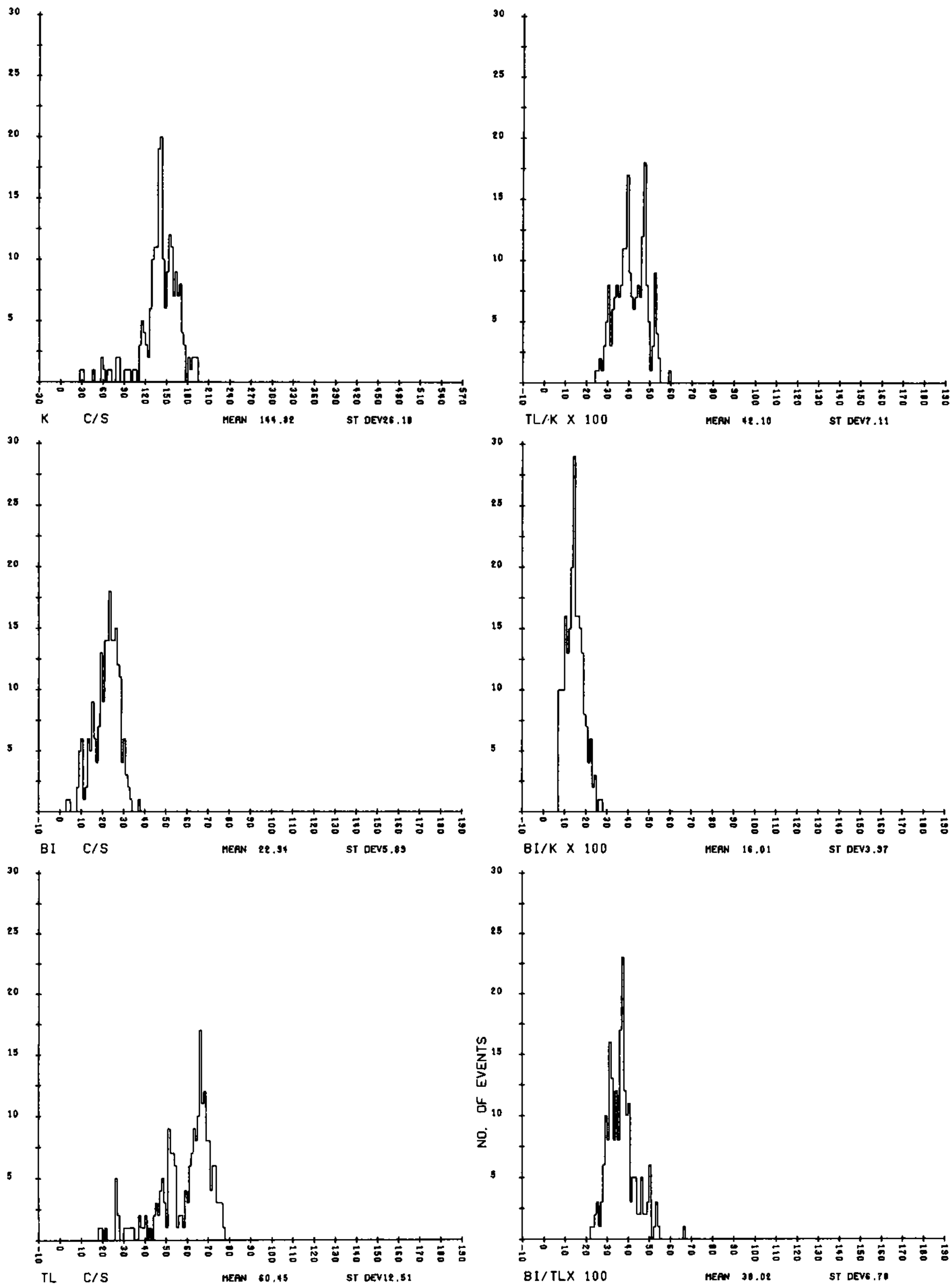
A38 BRIGHAM CITY



A 39 BRIGHAM CITY

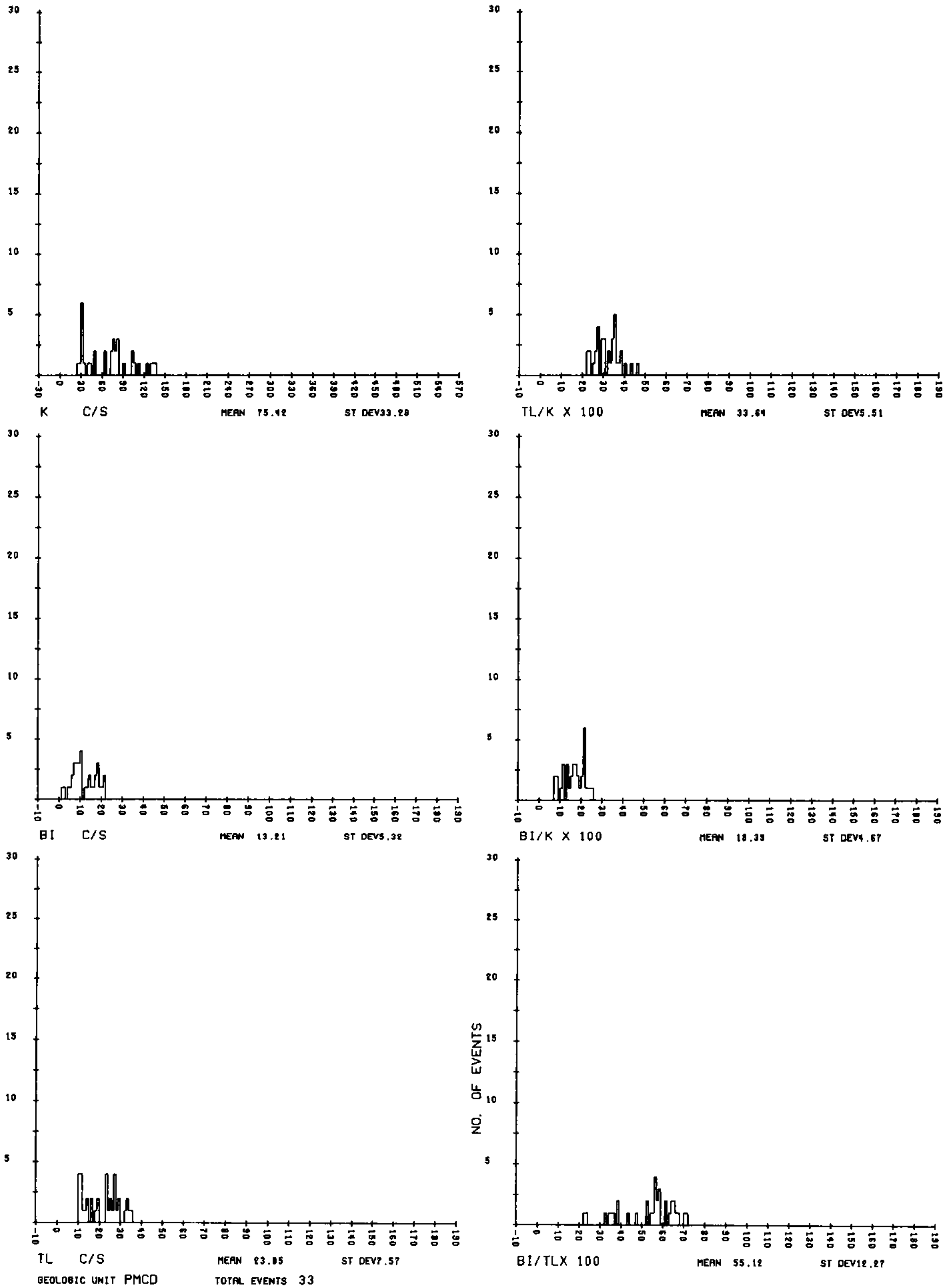


A40 BRIGHAM CITY

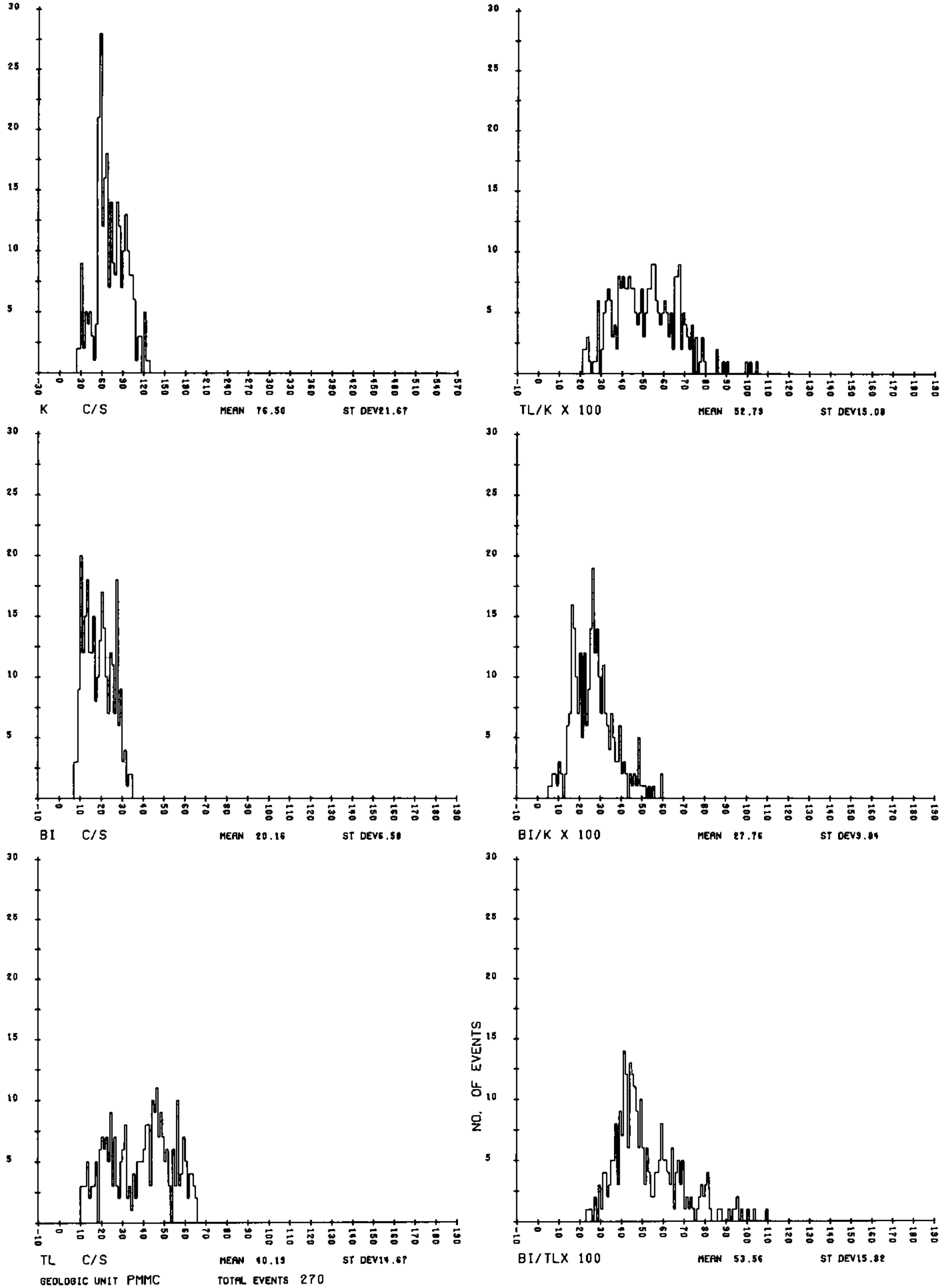


GEOLOGIC UNIT PЄMF TOTAL EVENTS 205

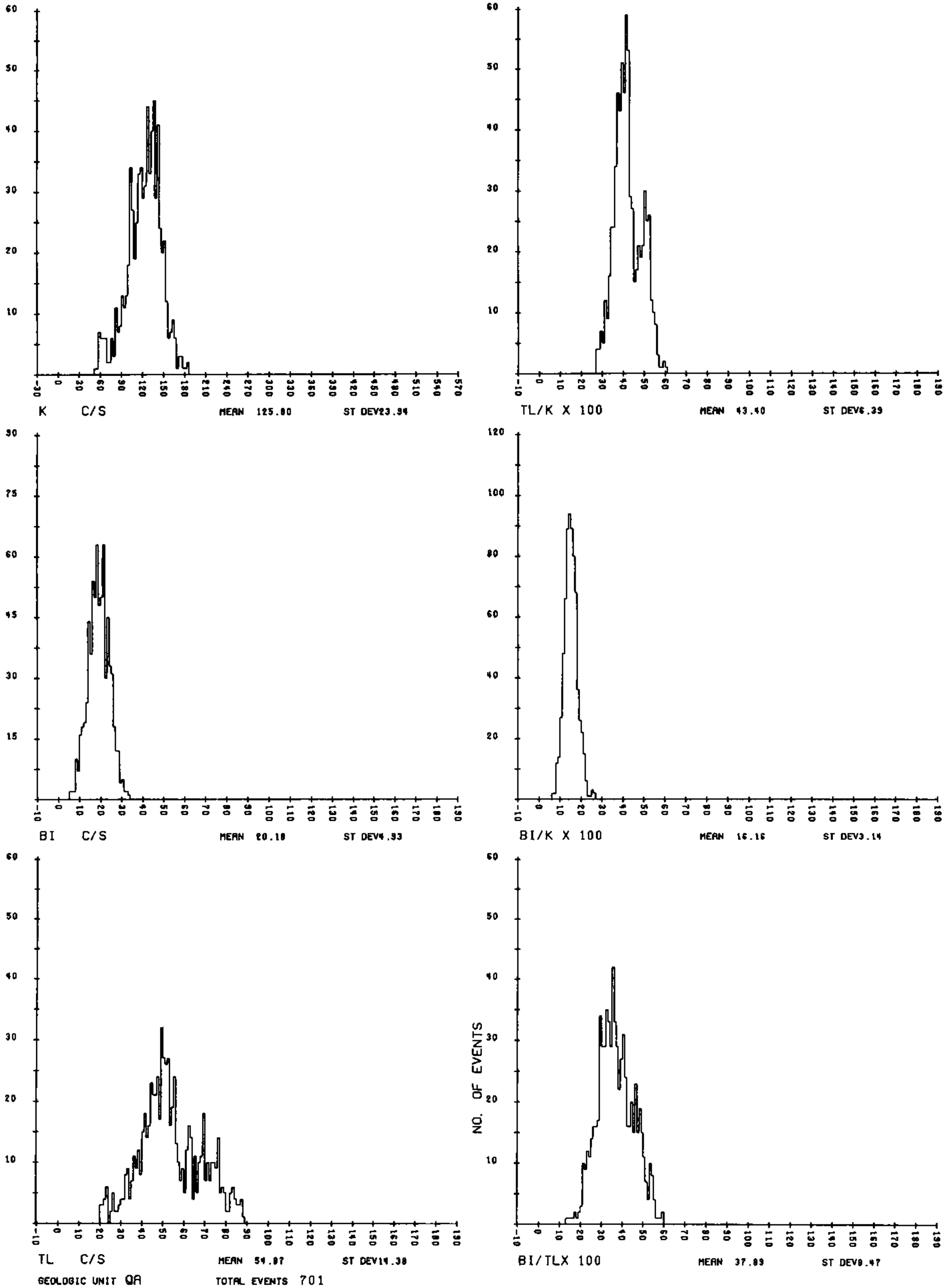
A41 BRIGHAM CITY

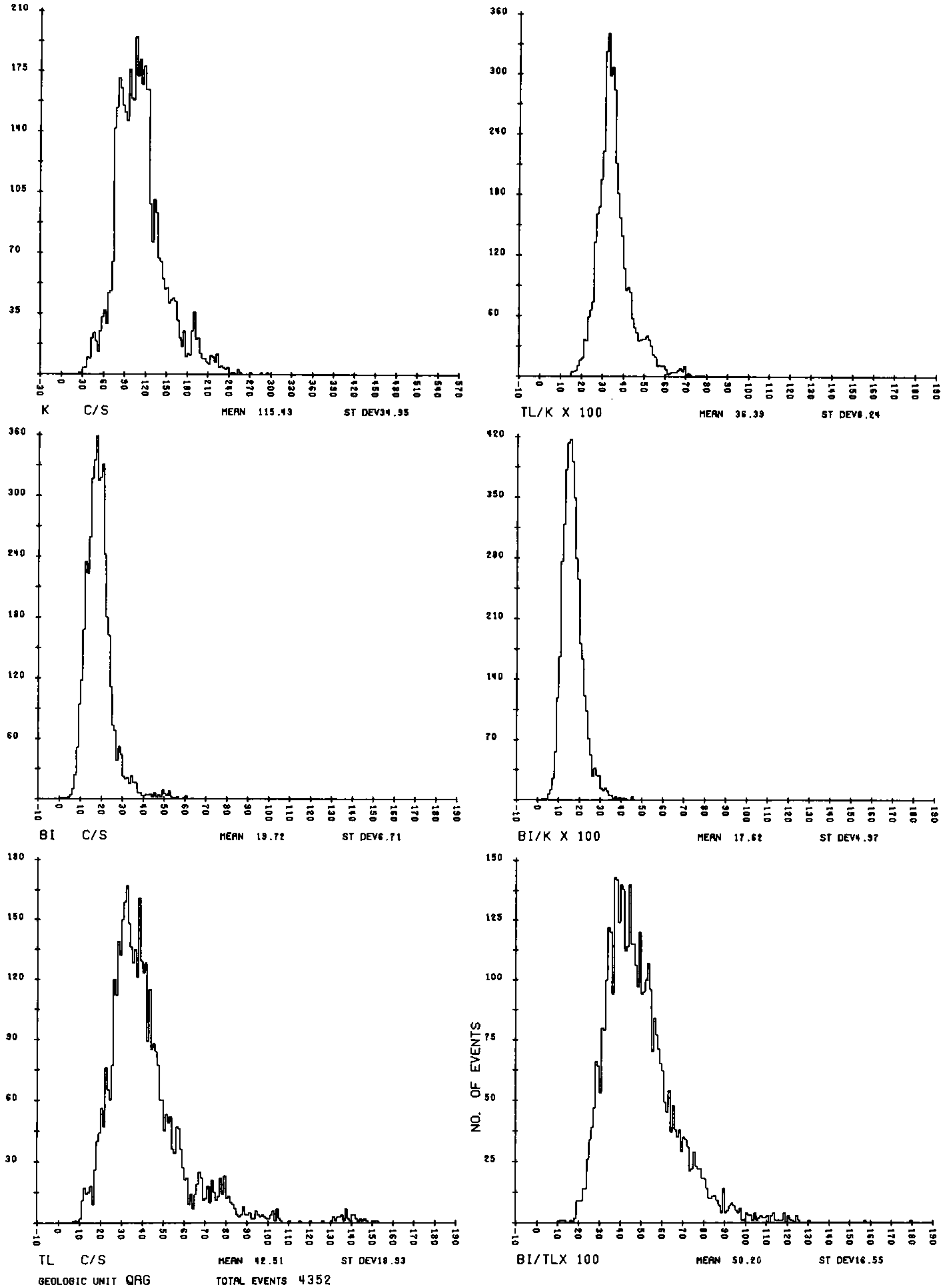


A42 BRIGHAM CITY

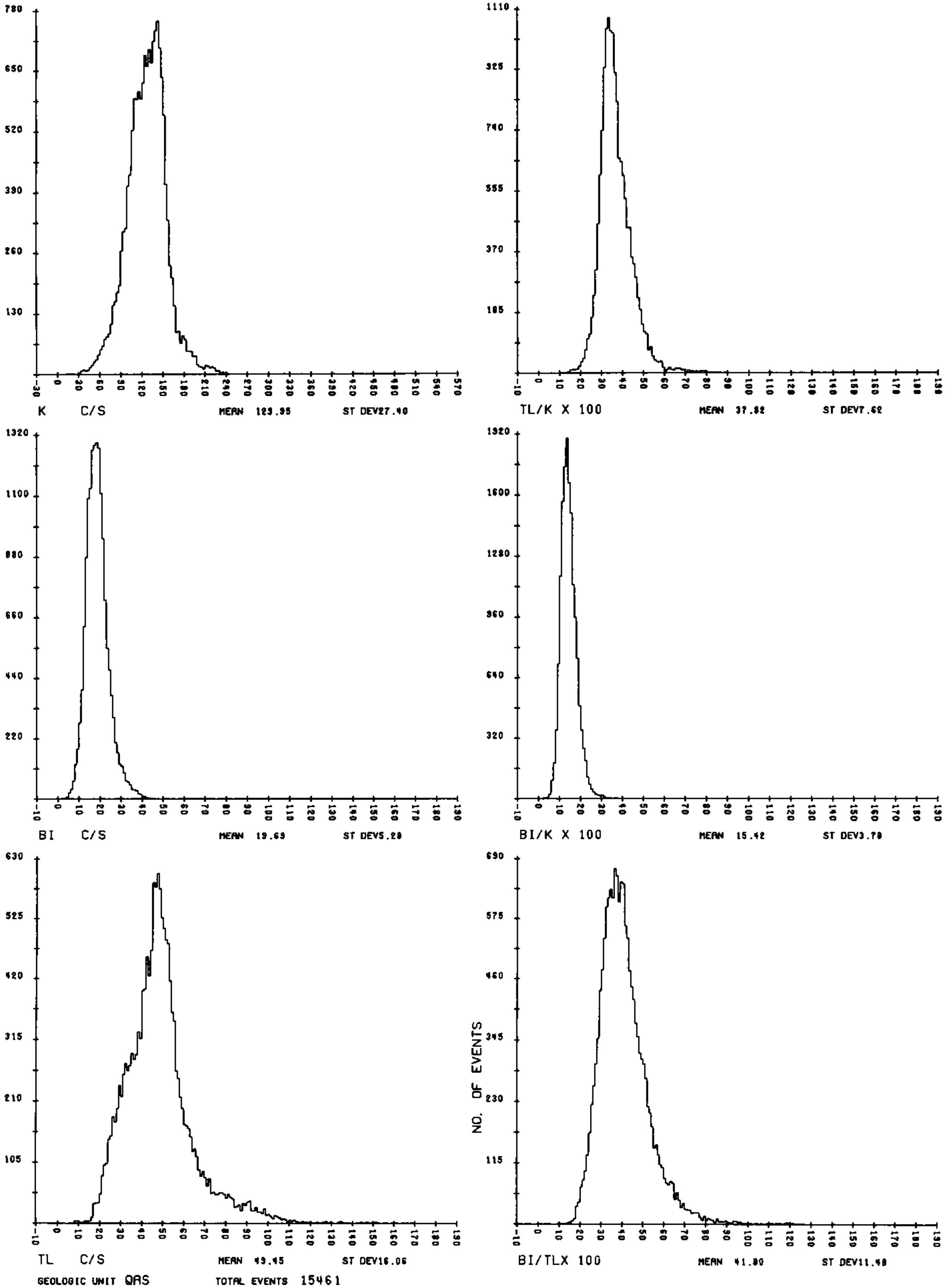


A 43 BRIGHAM CITY

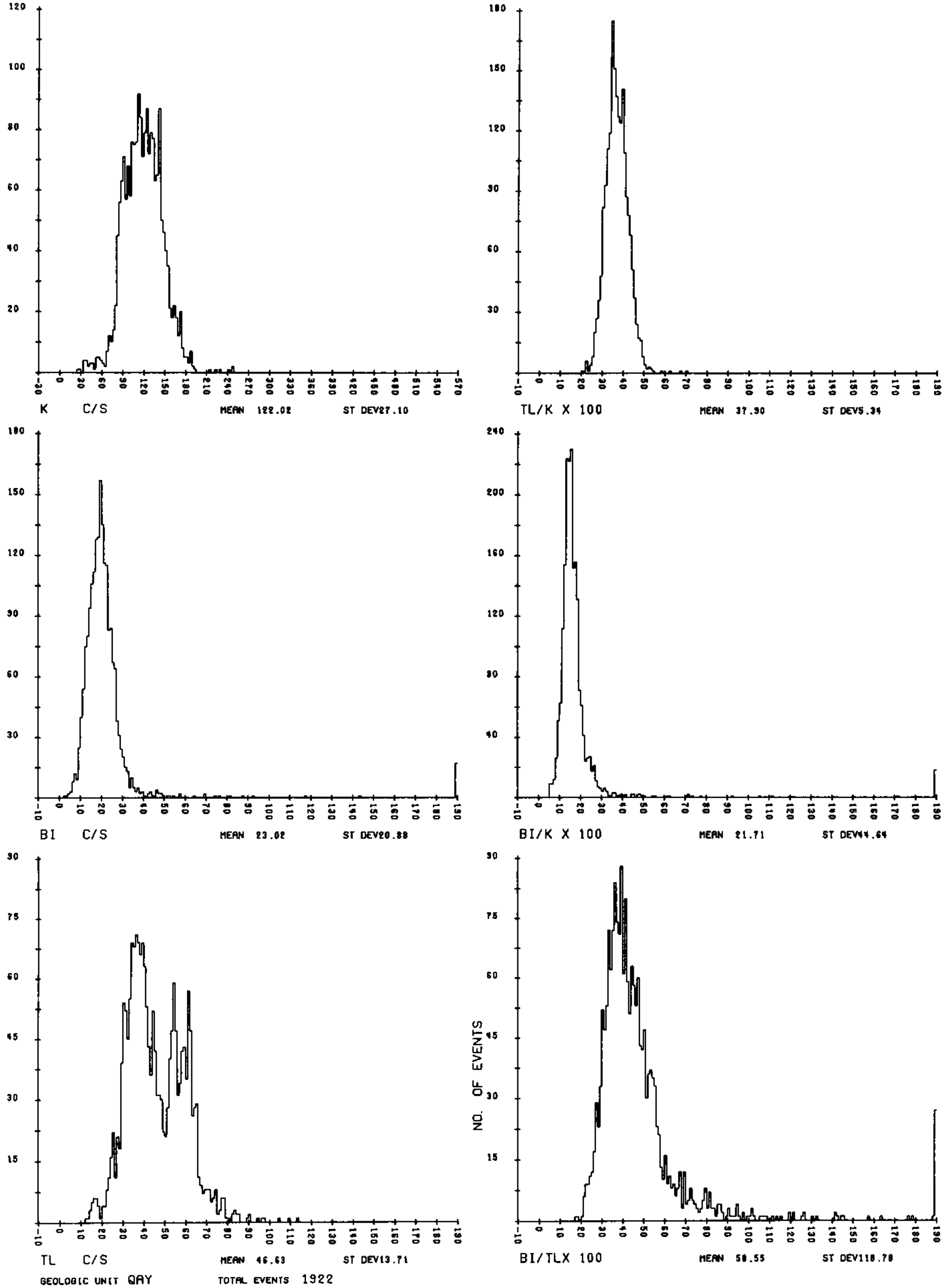

K C/S
MEAN 125.80
ST DEV23.94
TL/K X 100
MEAN 43.40
ST DEV6.39
BI C/S
MEAN 20.18
ST DEV4.93
BI/K X 100
MEAN 16.16
ST DEV3.14
TL C/S
MEAN 54.87
ST DEV14.38
BI/TLX 100
MEAN 37.89
ST DEV9.47
NO. OF EVENTS
GEOLOGIC UNIT QA
TOTAL EVENTS 701



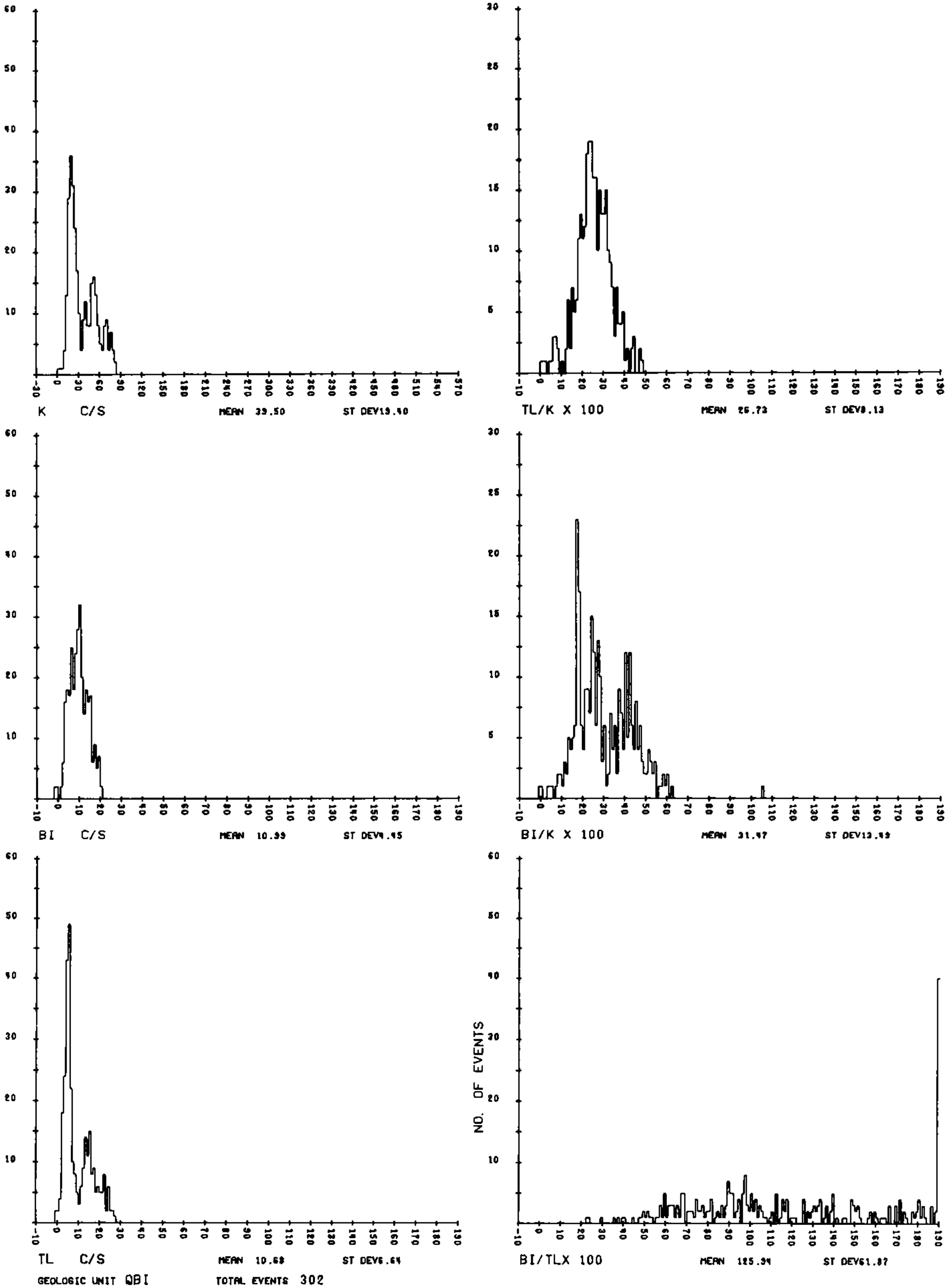
A45 BRIGHAM CITY



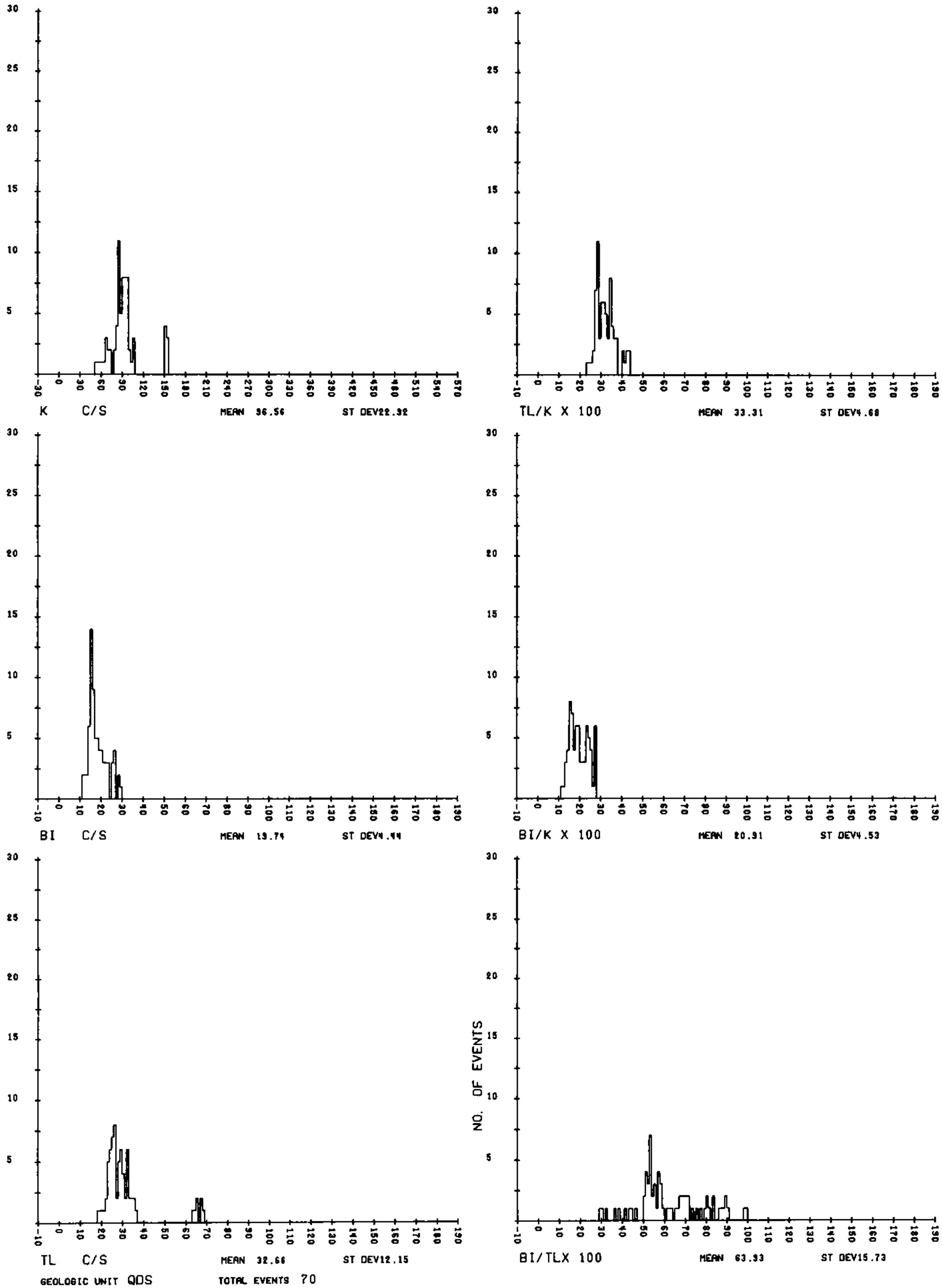
A46 BRIGHAM CITY



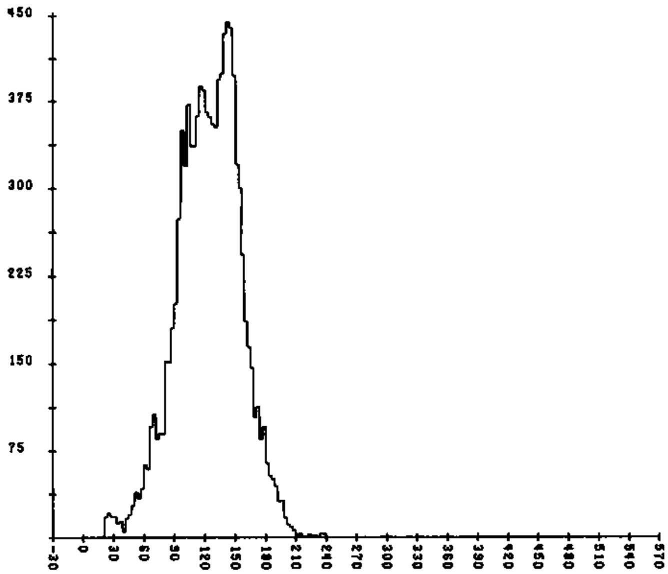
A47 BRIGHAM CITY



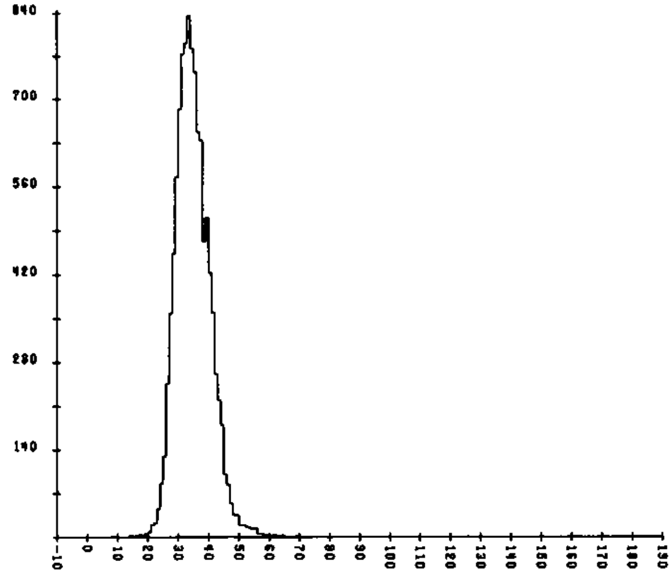
A48 BRIGHAM CITY



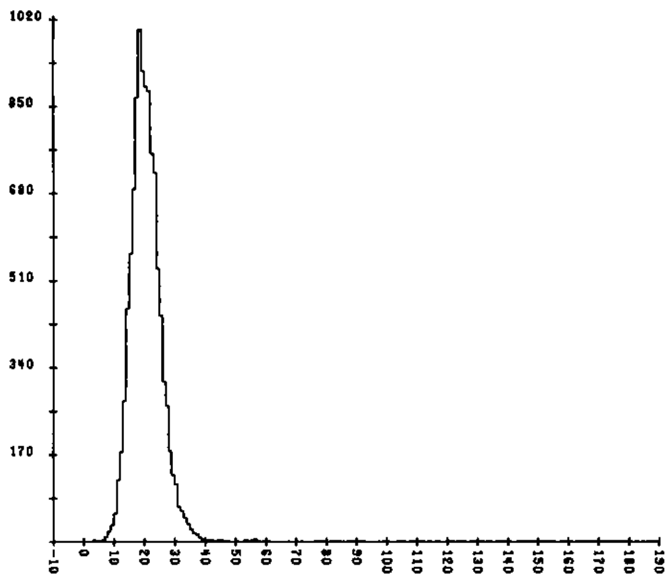
A49 BRIGHAM CITY



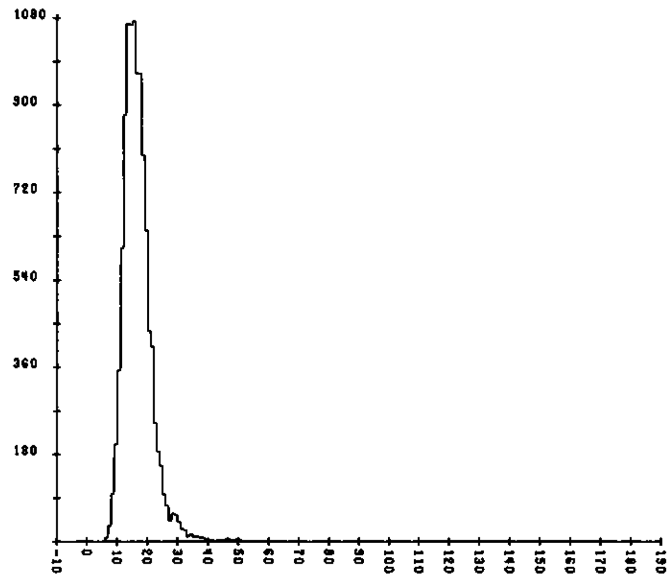
K C/S MEAN 127.14 ST DEV31.33



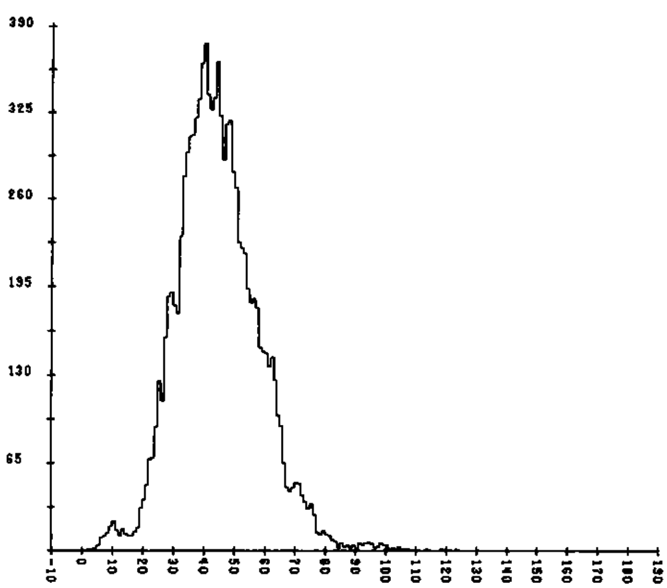
TL/K X 100 MEAN 35.33 ST DEV5.68



BI C/S MEAN 21.57 ST DEV5.02

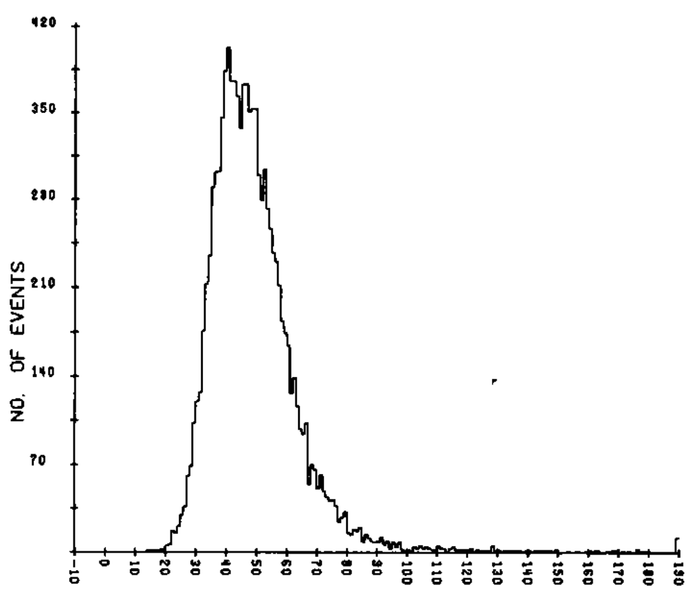


BI/K X 100 MEAN 17.74 ST DEV5.25



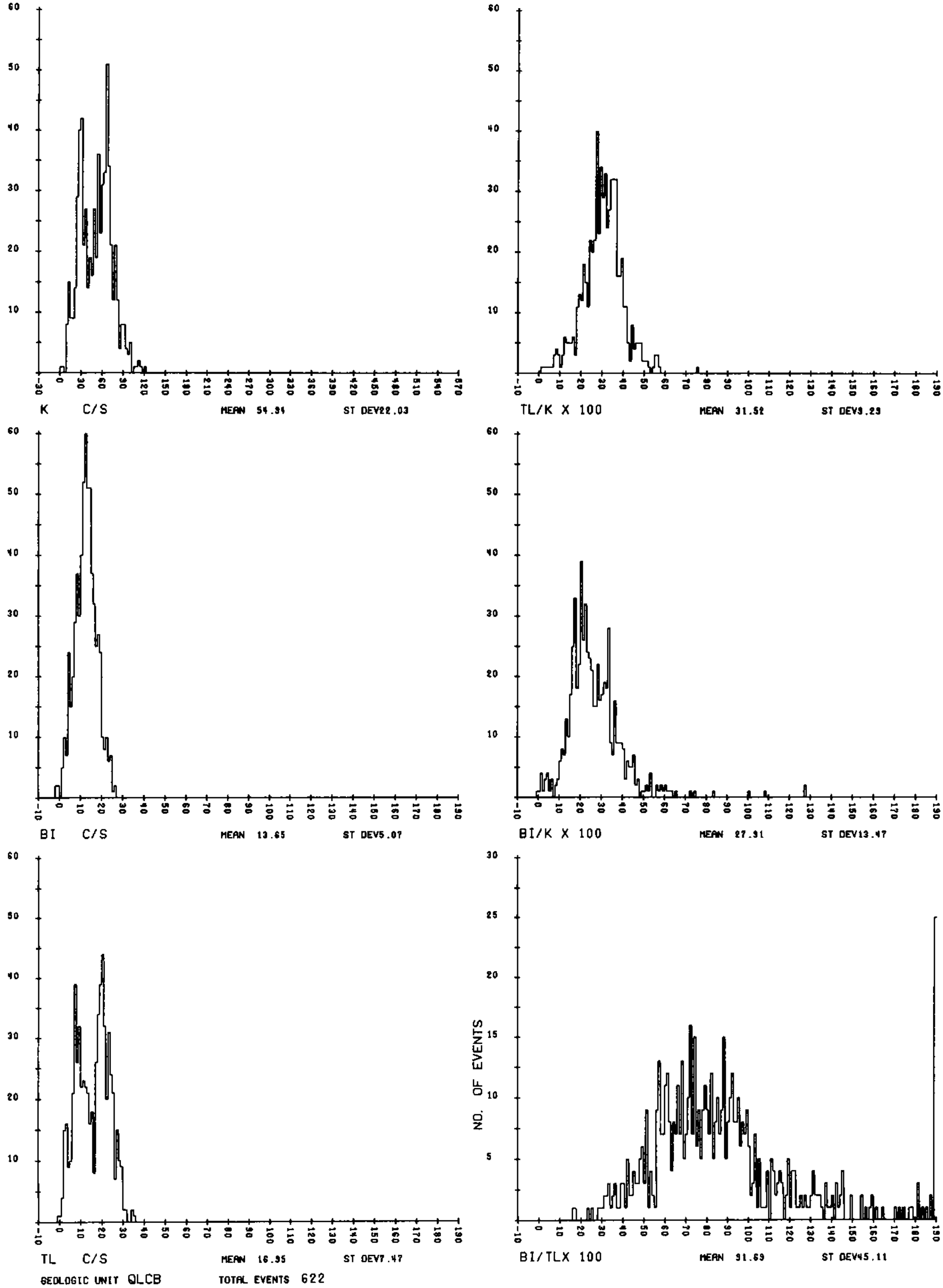
TL C/S MEAN 45.66 ST DEV13.53

GEOLOGIC UNIT QLC TOTAL EVENTS 10719

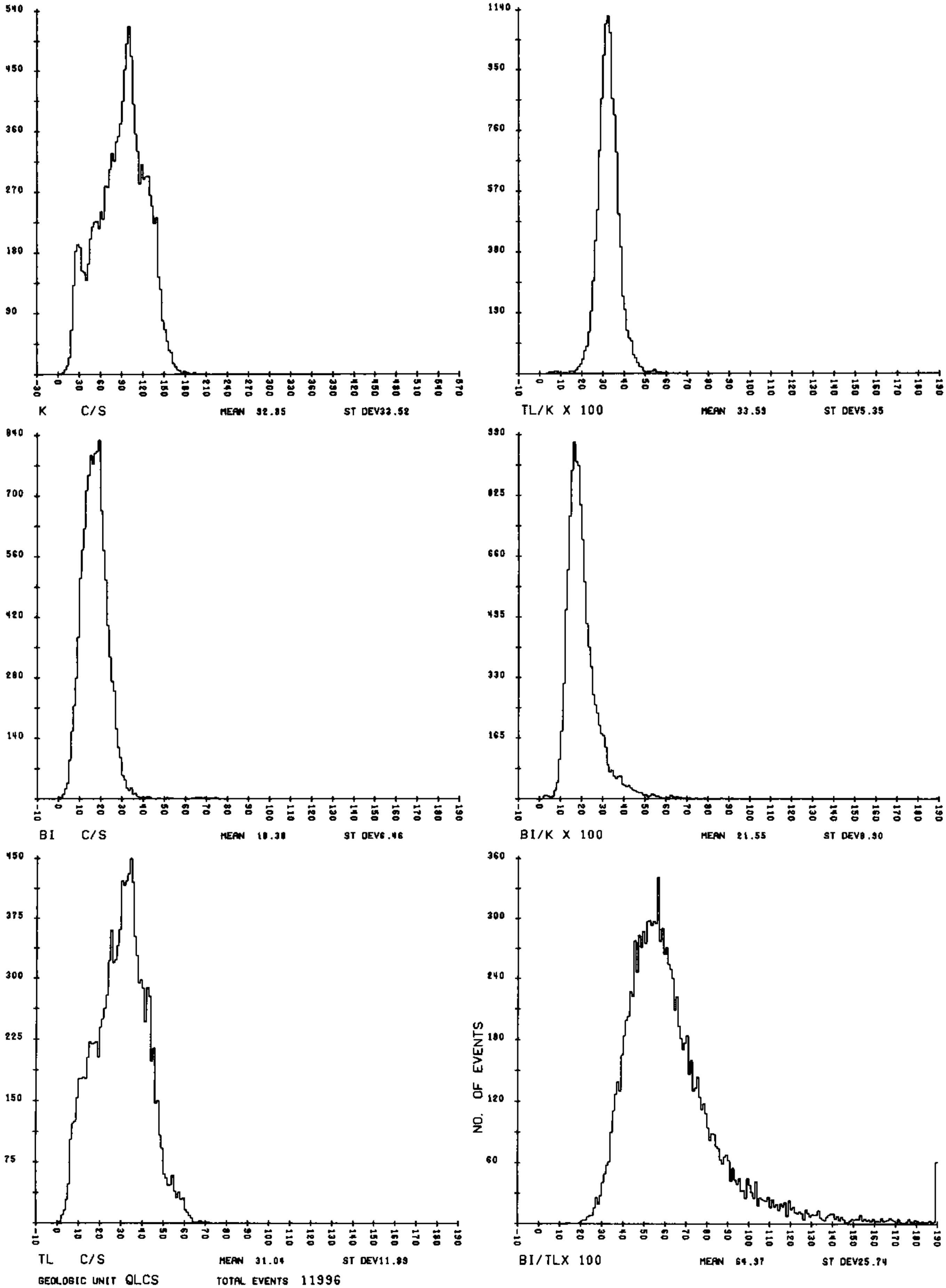


BI/TLX 100 MEAN 50.18 ST DEV16.31

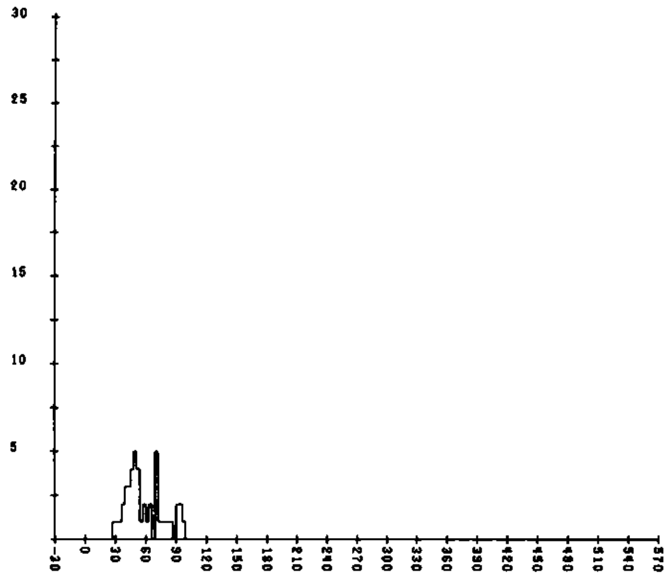
A 50 BRIGHAM CITY



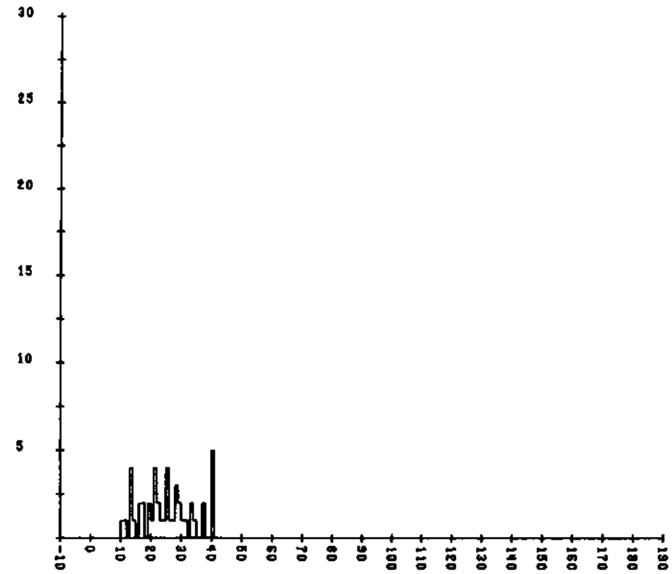
A 51 BRIGHAM CITY



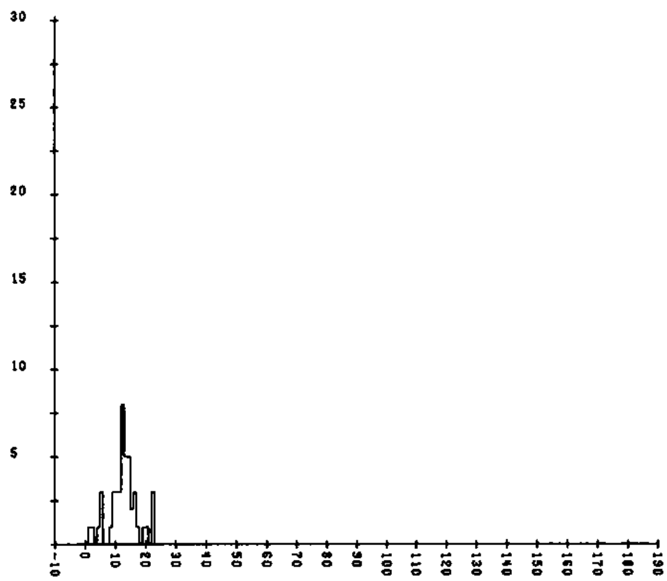
A52 BRIGHAM CITY



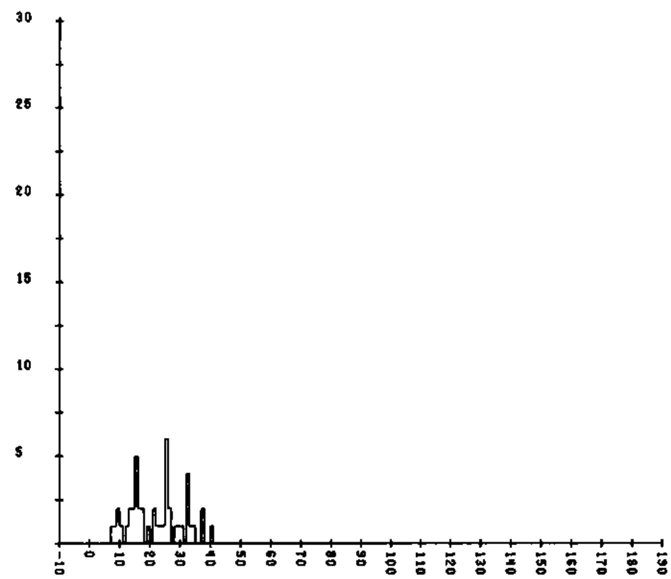
K C/S MEAN 62.33 ST DEV18.36



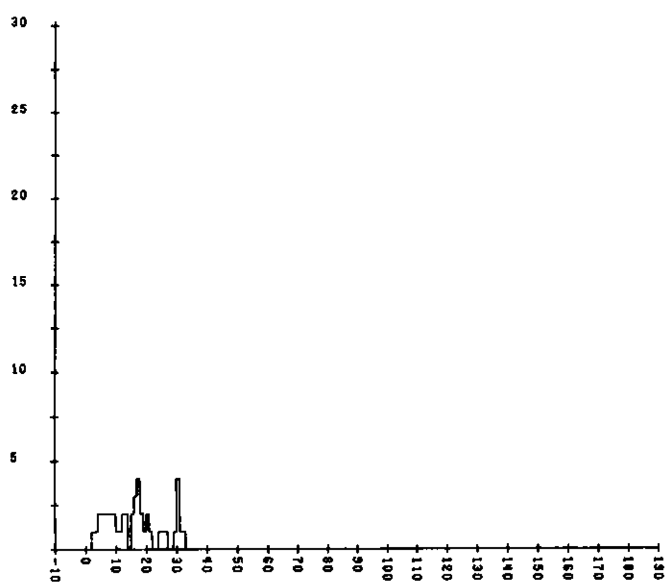
TL/K X 100 MEAN 26.61 ST DEV8.56



BI C/S MEAN 13.38 ST DEV4.73

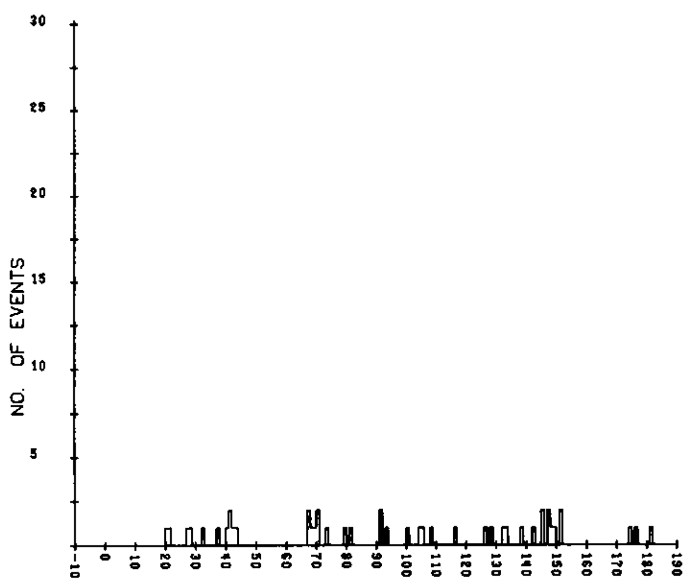


BI/K X 100 MEAN 23.52 ST DEV8.65

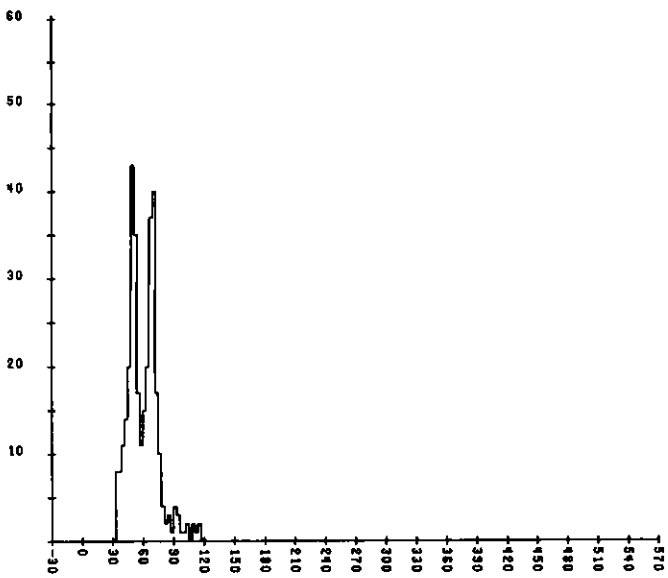


TL C/S MEAN 17.36 ST DEV8.61

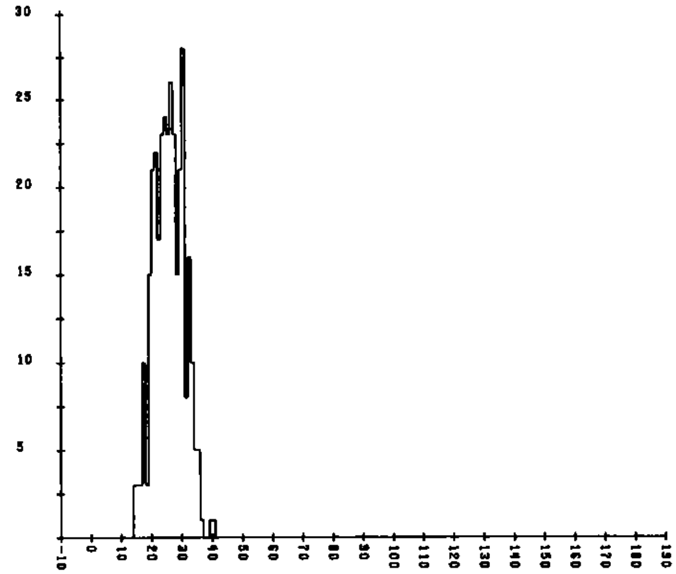
GEOLOGIC UNIT QLO TOTAL EVENTS 44



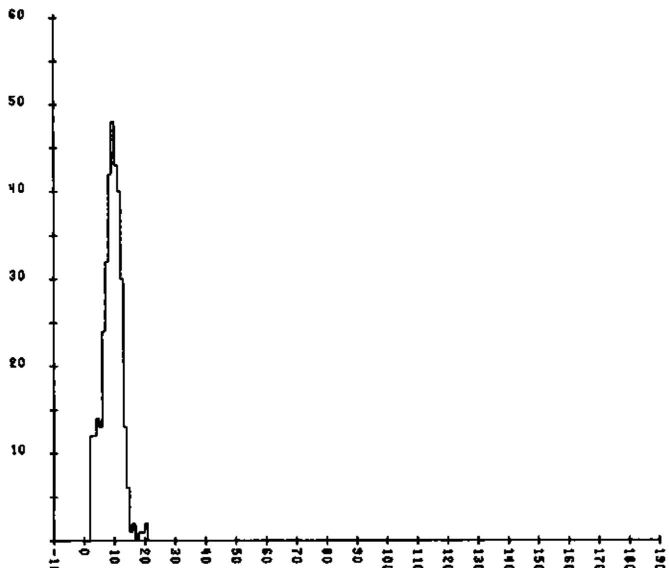
BI/TLX 100 MEAN 33.52 ST DEV46.71



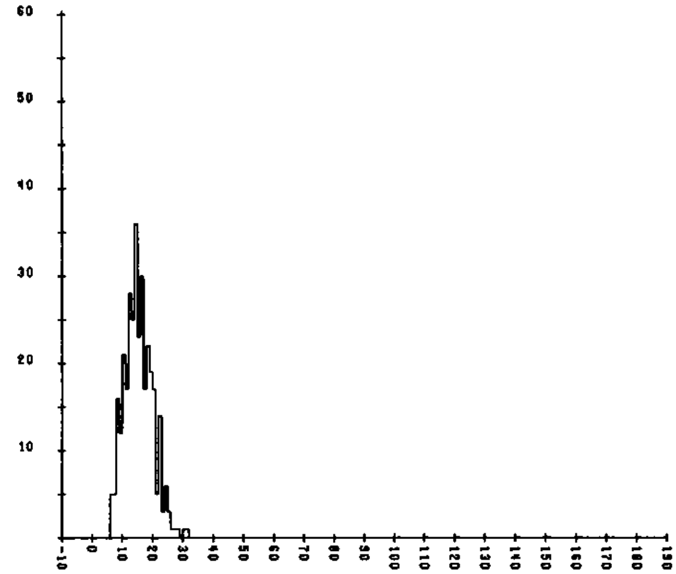
K C/S MEAN 64.09 ST DEV14.43



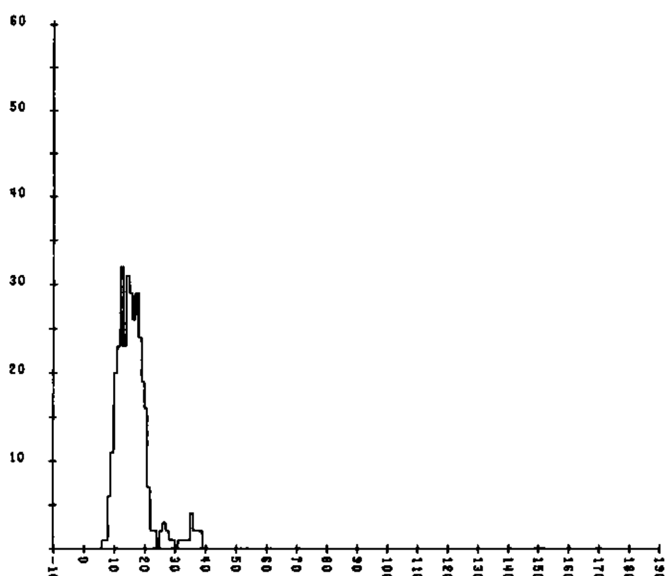
TL/K X 100 MEAN 26.97 ST DEV4.78



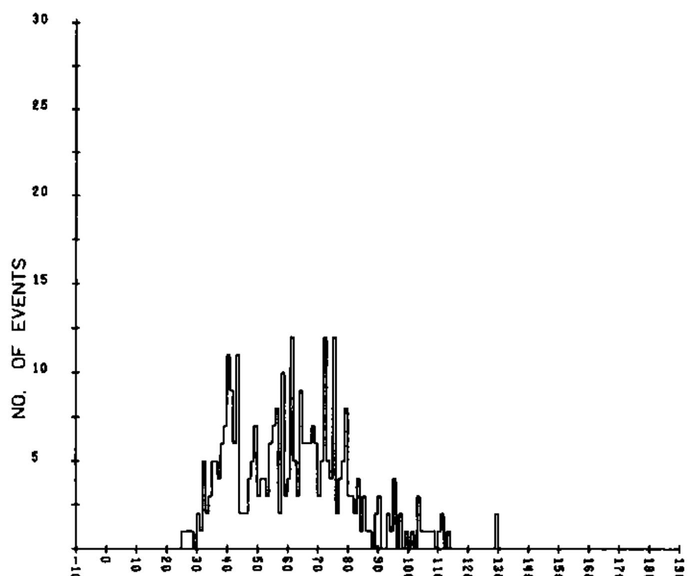
BI C/S MEAN 10.41 ST DEV2.90



BI/K X 100 MEAN 16.55 ST DEV4.47

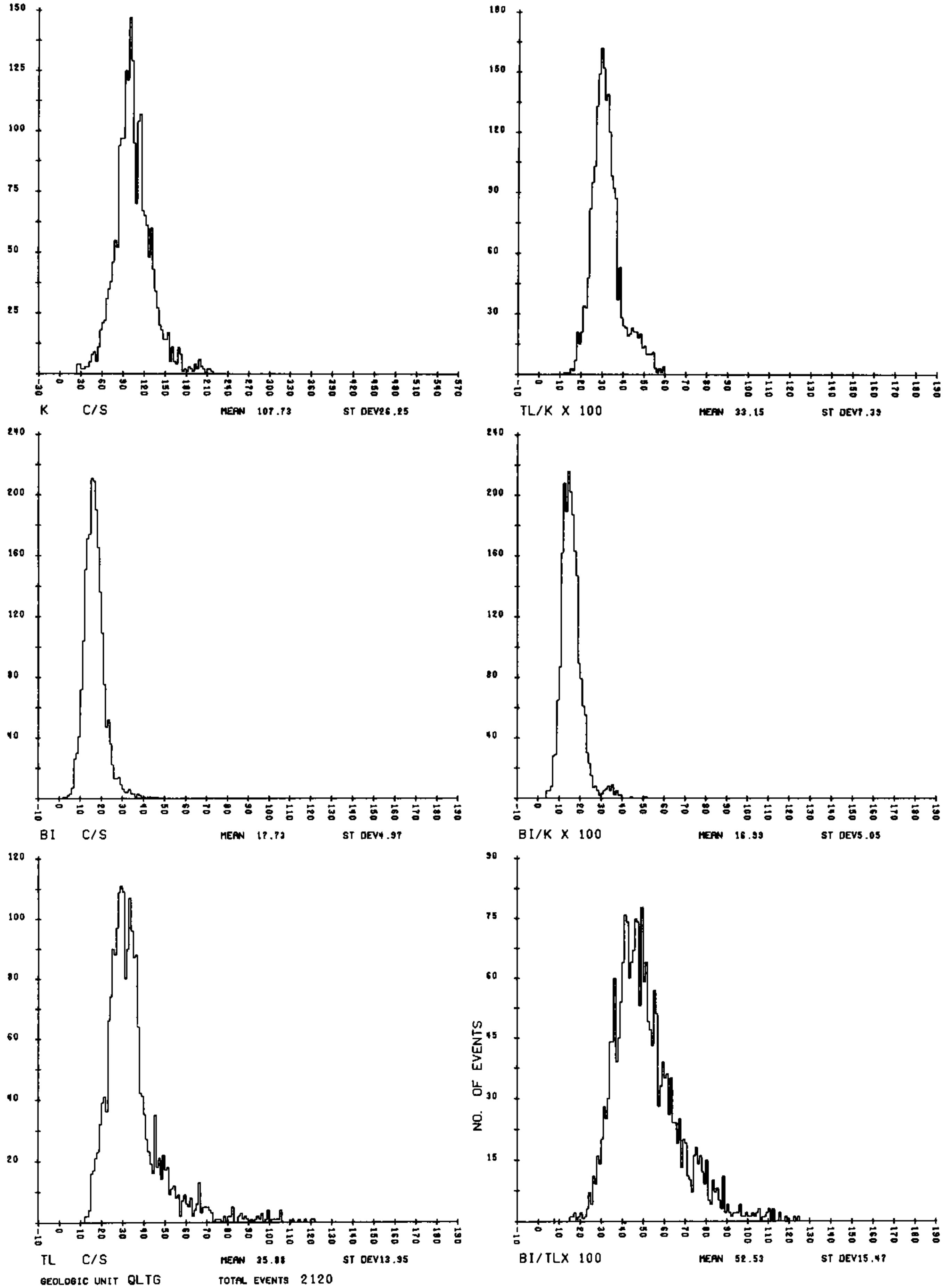


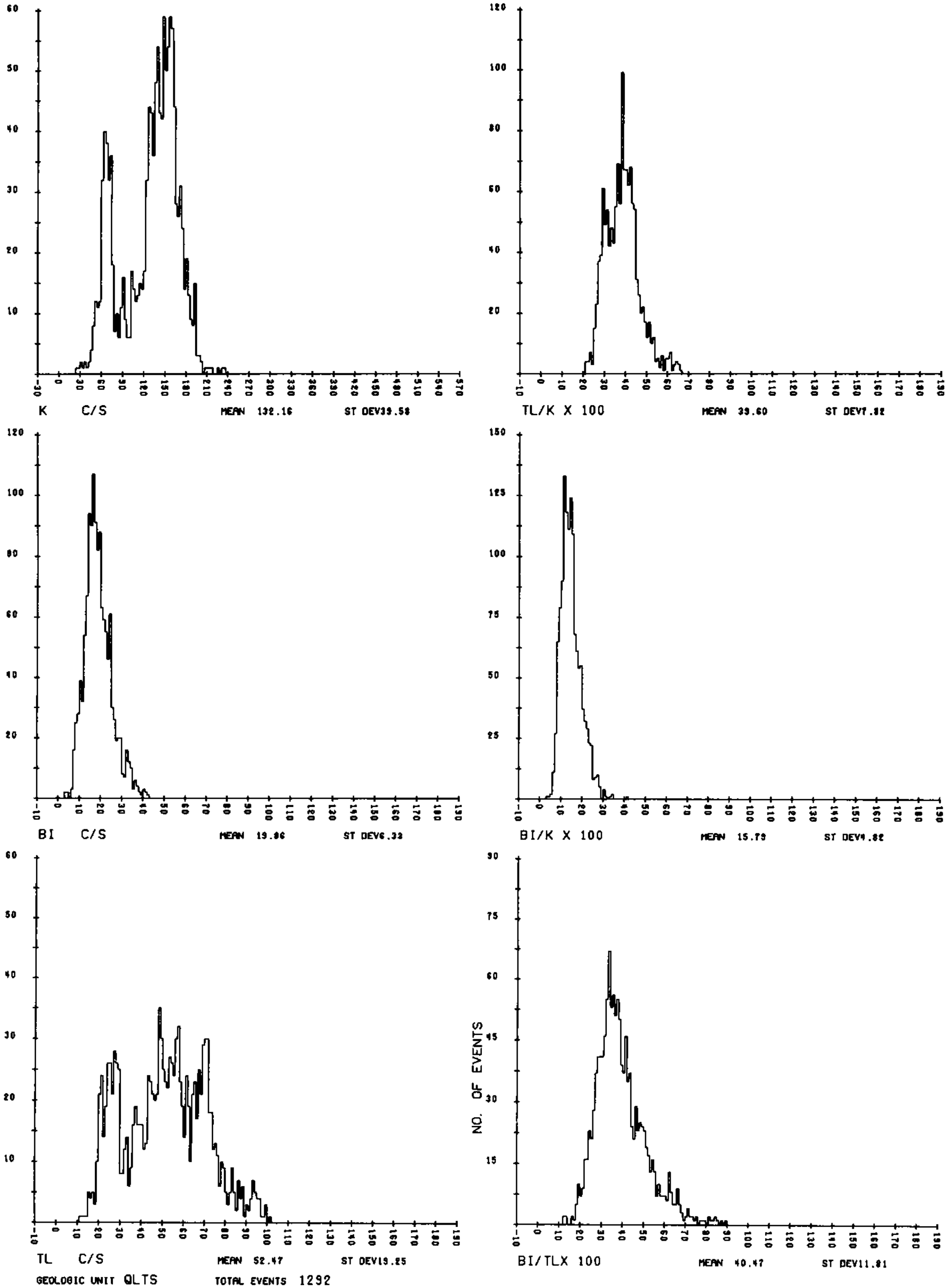
TL C/S MEAN 17.35 ST DEV5.63

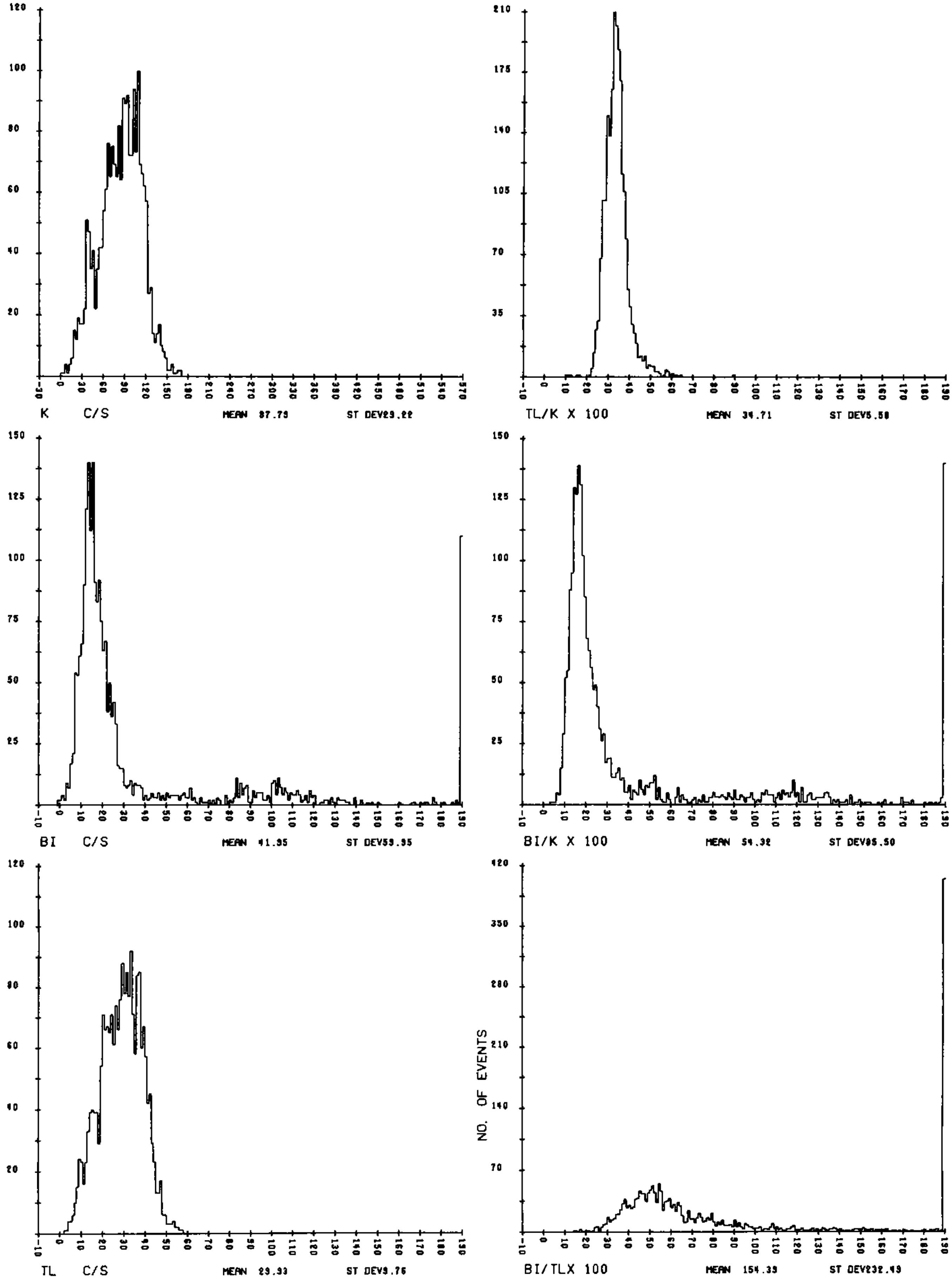


BI/TLX 100 MEAN 63.09 ST DEV19.58

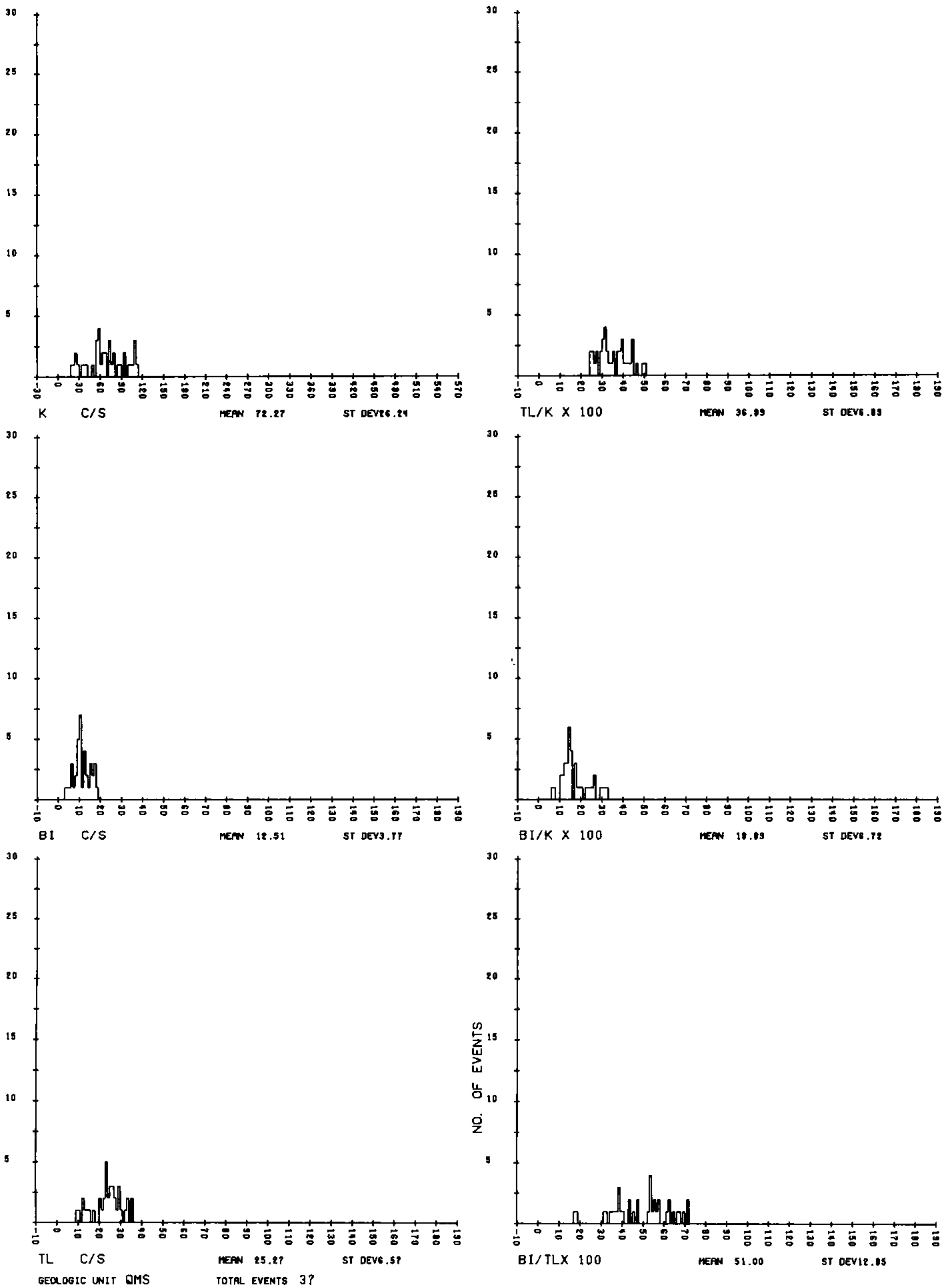
GEOLOGIC UNIT QLSA TOTAL EVENTS 324

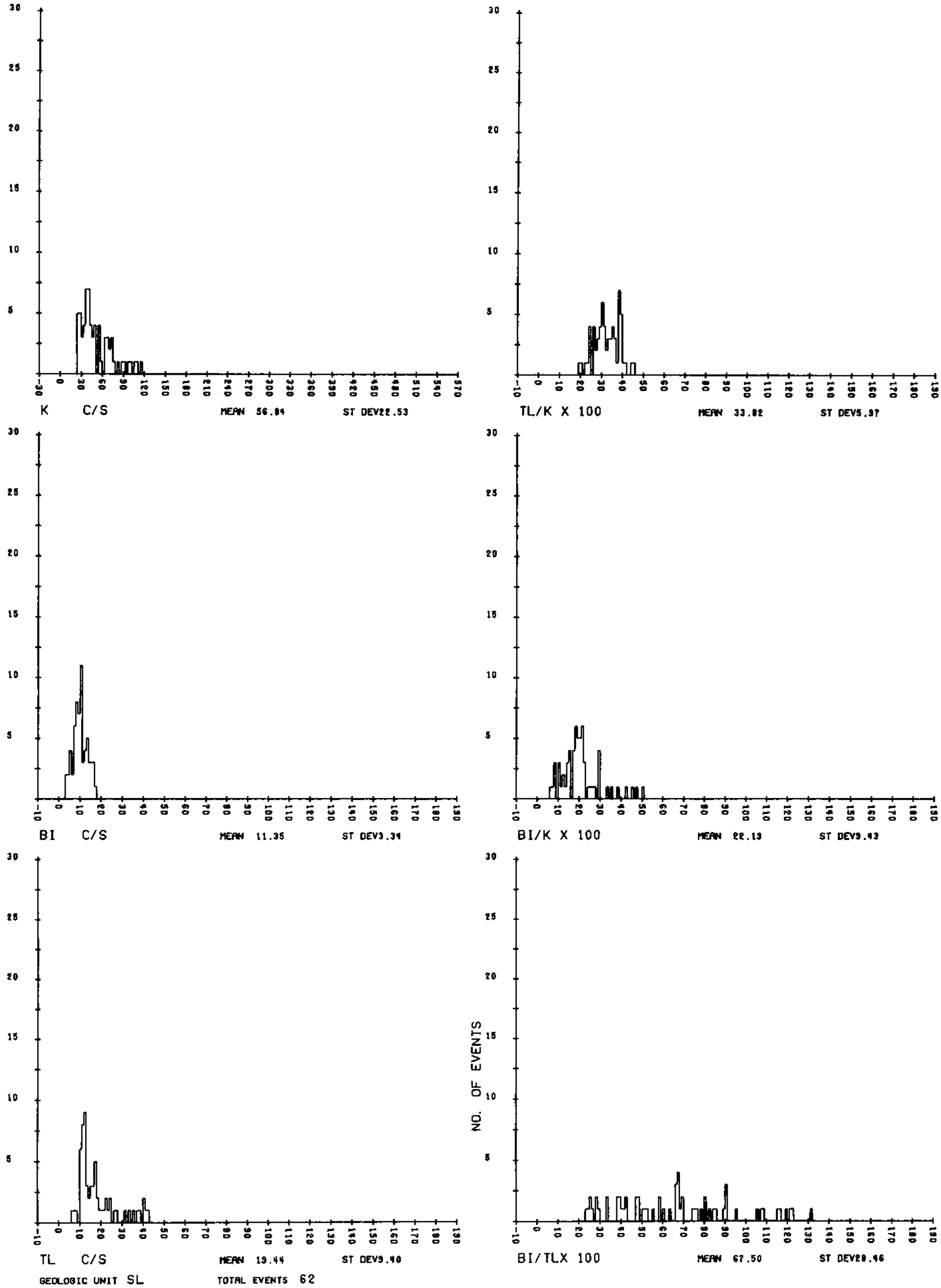

K C/S
MEAN 107.73
ST DEV26.25
TL/K X 100
MEAN 33.15
ST DEV7.39
BI C/S
MEAN 17.73
ST DEV4.97
BI/K X 100
MEAN 16.99
ST DEV5.05
TL C/S
MEAN 35.88
ST DEV13.95
BI/TLX 100
MEAN 52.53
ST DEV15.47
NO. OF EVENTS
GEOLOGIC UNIT QLTG
TOTAL EVENTS 2120


K C/S
MEAN 132.16
ST DEV39.58
TL/K X 100
MEAN 39.60
ST DEV7.82
BI C/S
MEAN 19.96
ST DEV6.33
BI/K X 100
MEAN 15.79
ST DEV4.82
TL C/S
MEAN 52.47
ST DEV19.25
GEOLOGIC UNIT QLTS
TOTAL EVENTS 1292
NO. OF EVENTS
BI/TLX 100
MEAN 40.47
ST DEV11.81

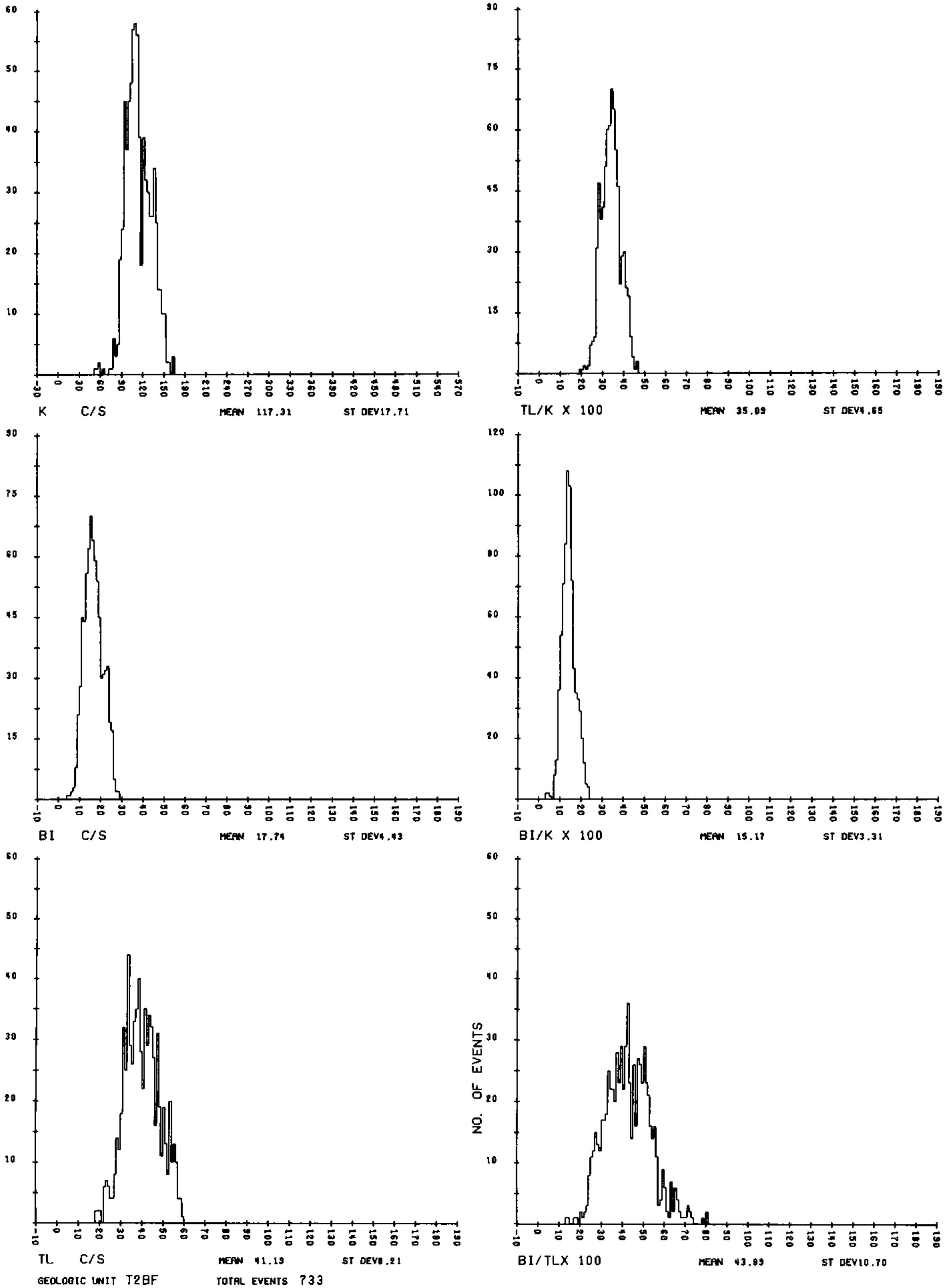


GEOLOGIC UNIT QM TOTAL EVENTS 2131

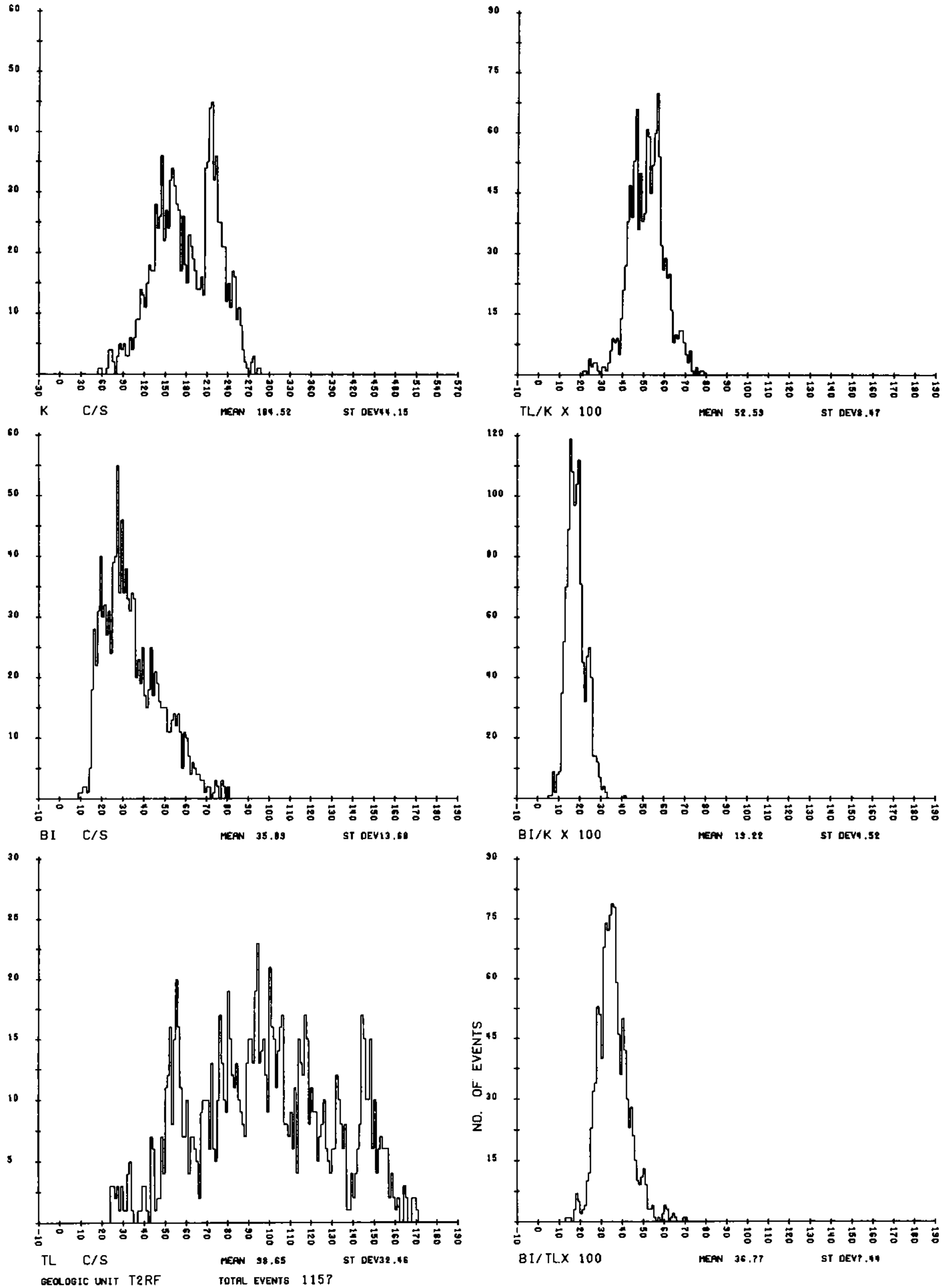

K C/S
MEAN 72.27
ST DEV26.24
TL/K X 100
MEAN 36.89
ST DEV6.83
BI C/S
MEAN 12.51
ST DEV3.77
BI/K X 100
MEAN 18.89
ST DEV6.72
TL C/S
MEAN 25.27
ST DEV6.57
NO. OF EVENTS
BI/TLX 100
MEAN 51.00
ST DEV12.85
GEOLOGIC UNIT QMS
TOTAL EVENTS 37



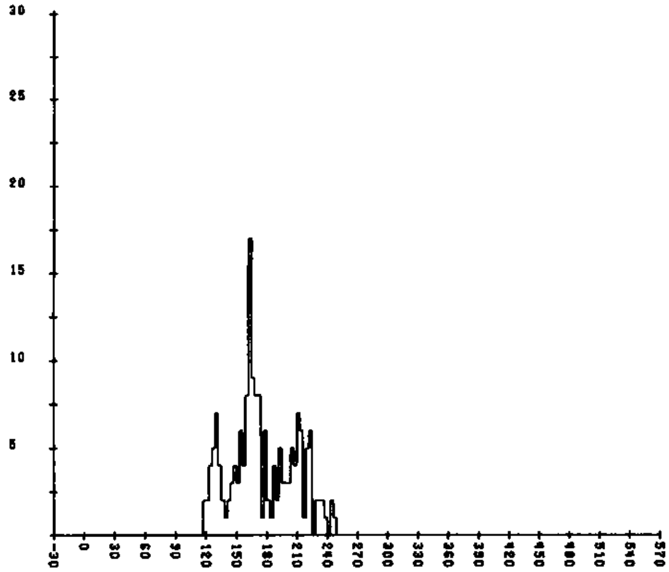
A59 BRIGHAM CITY



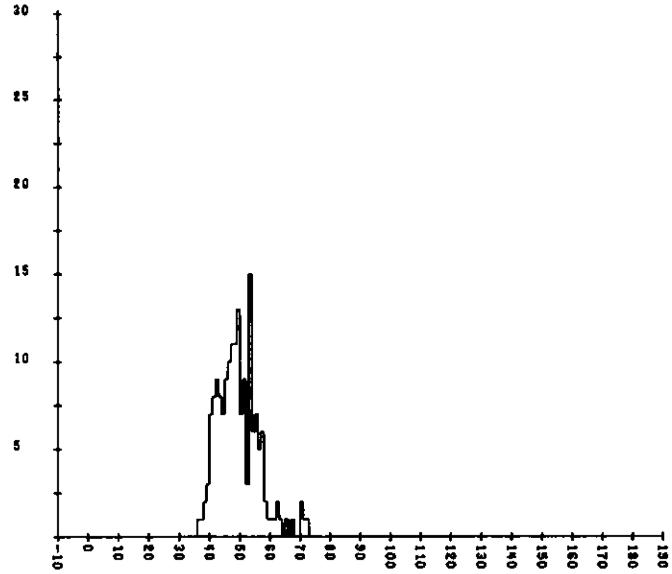
A60 BRIGHAM CITY



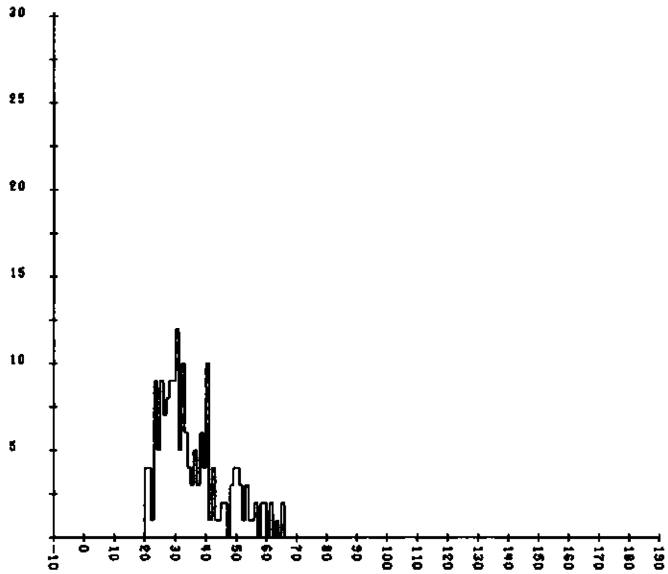
A61 BRIGHAM CITY



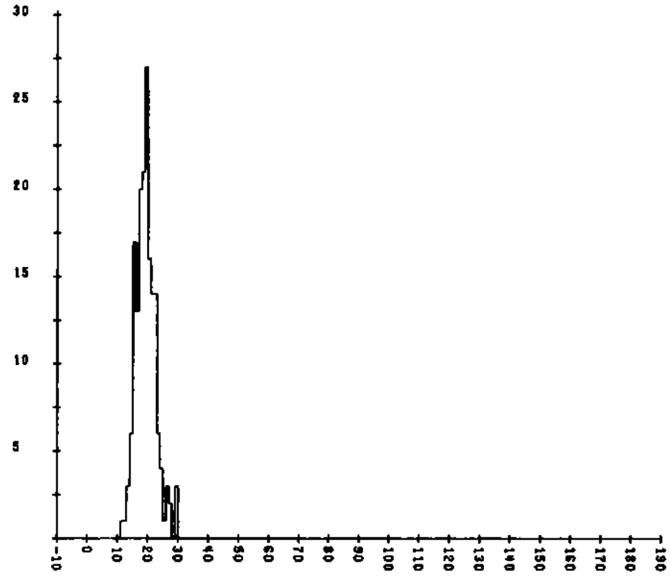
K C/S MEAN 173.47 ST DEV31.67



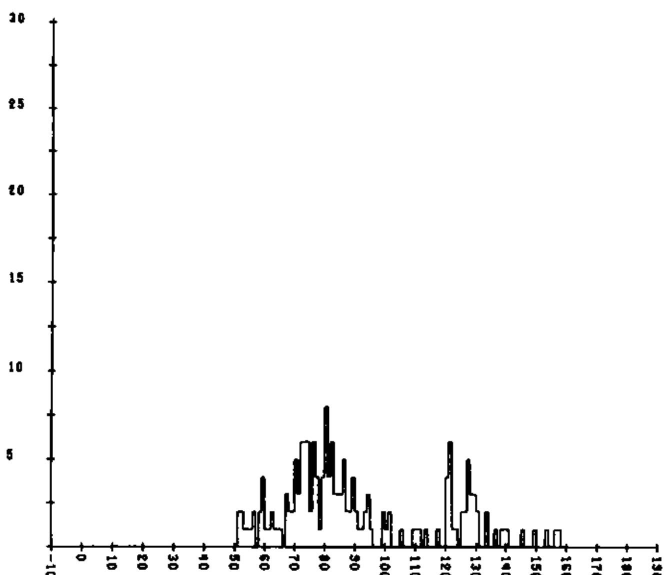
TL/K X 100 MEAN 50.63 ST DEV6.83



BI C/S MEAN 36.96 ST DEV10.69

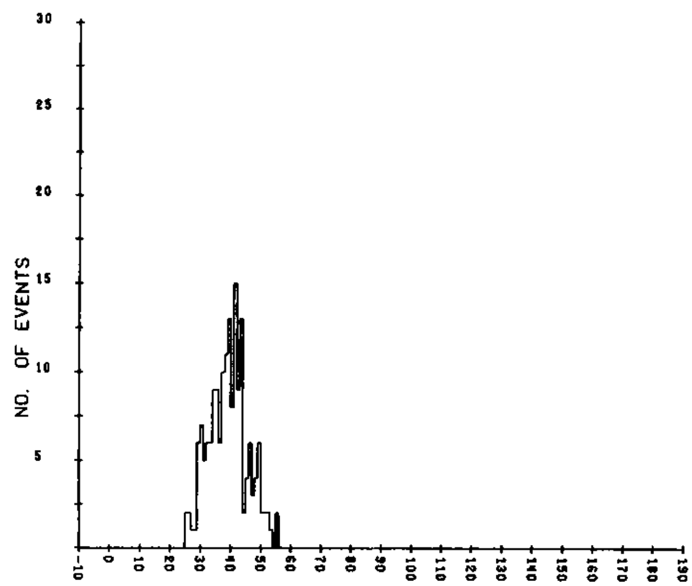


BI/K X 100 MEAN 20.39 ST DEV3.31

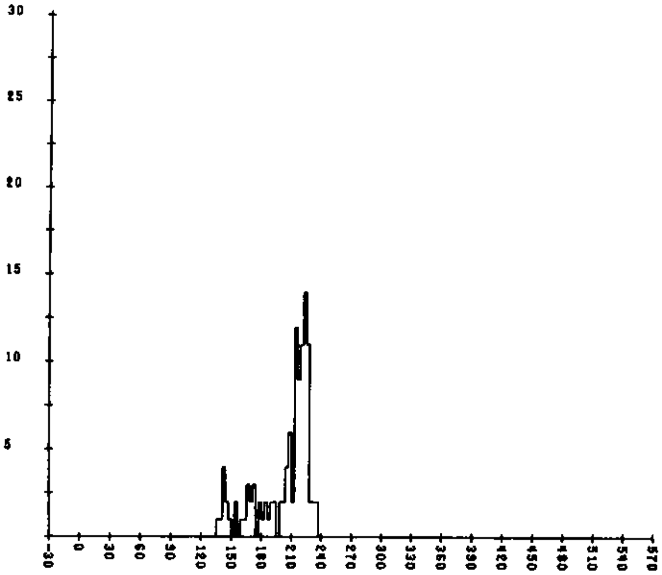


TL C/S MEAN 91.89 ST DEV25.23

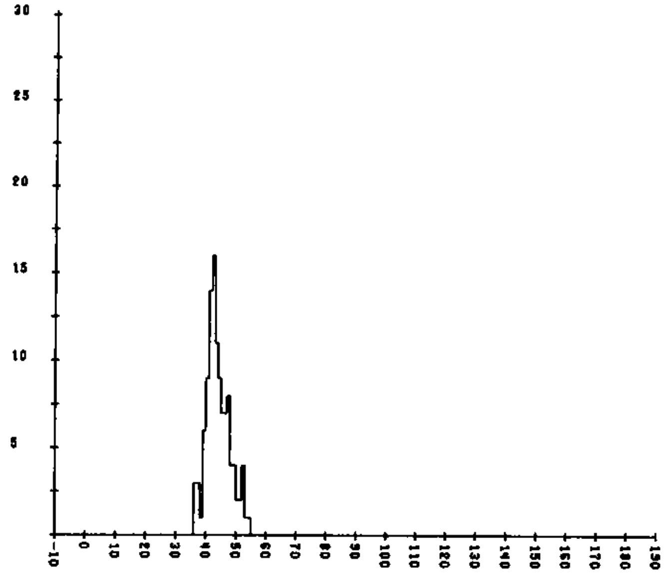
GEOLOGIC UNIT T2RP TOTAL EVENTS 171



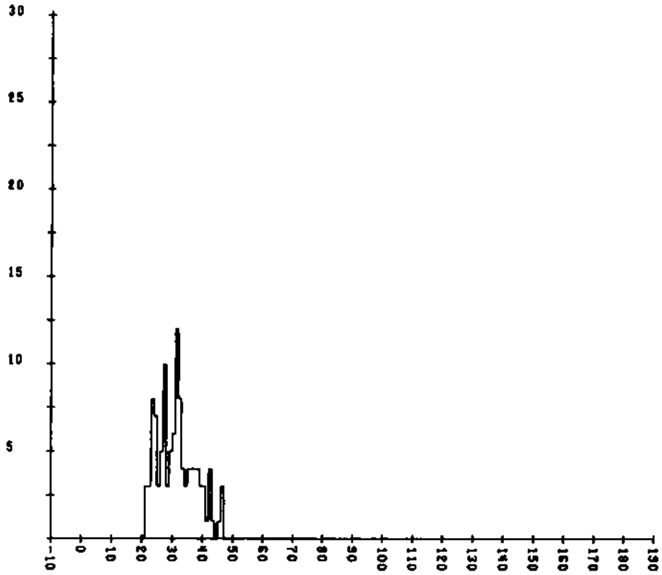
BI/TLX 100 MEAN 40.58 ST DEV6.25



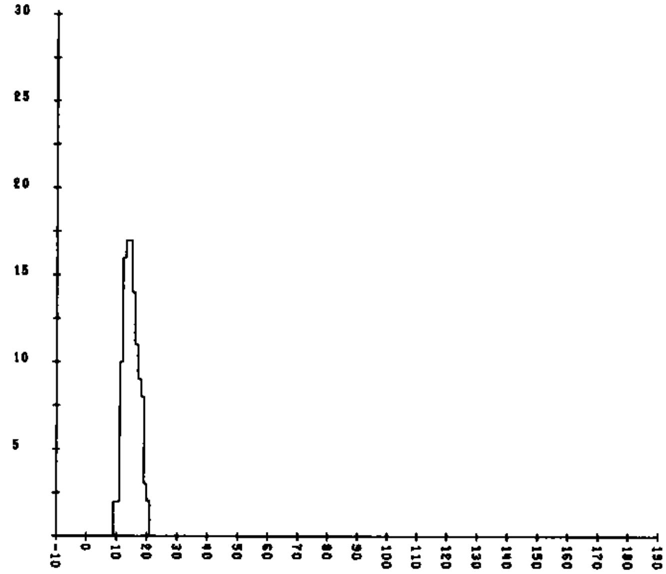
K C/S MEAN 207.35 ST DEV26.02



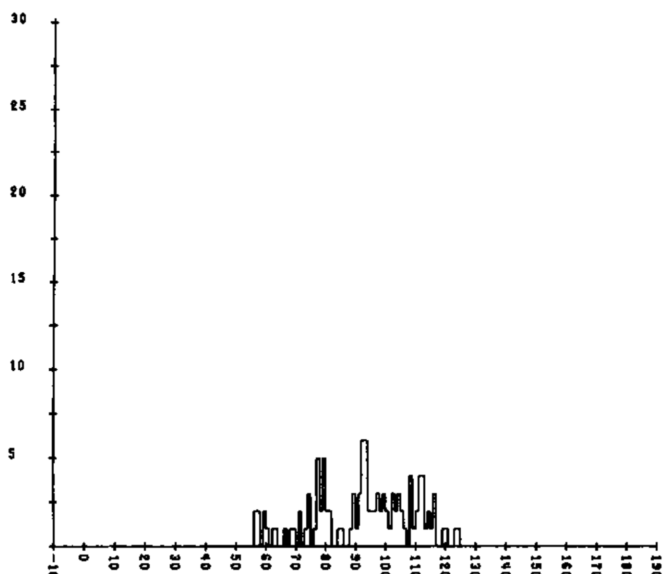
TL/K X 100 MEAN 45.33 ST DEV3.92



BI C/S MEAN 32.82 ST DEV6.23

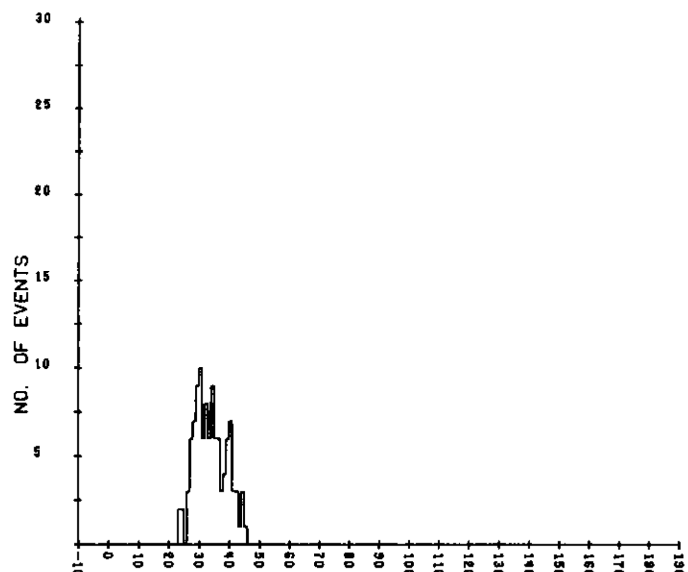


BI/K X 100 MEAN 15.86 ST DEV2.46

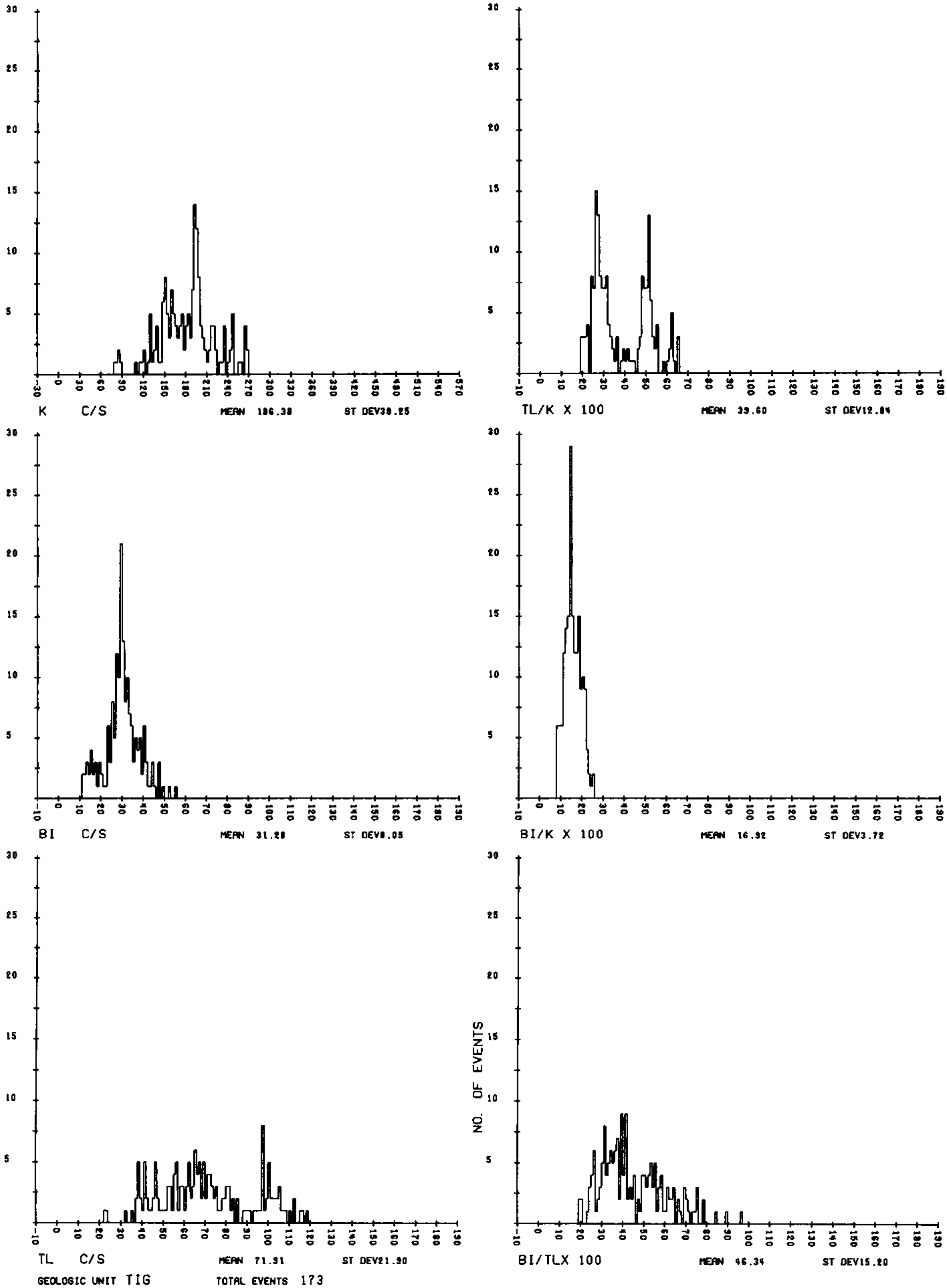


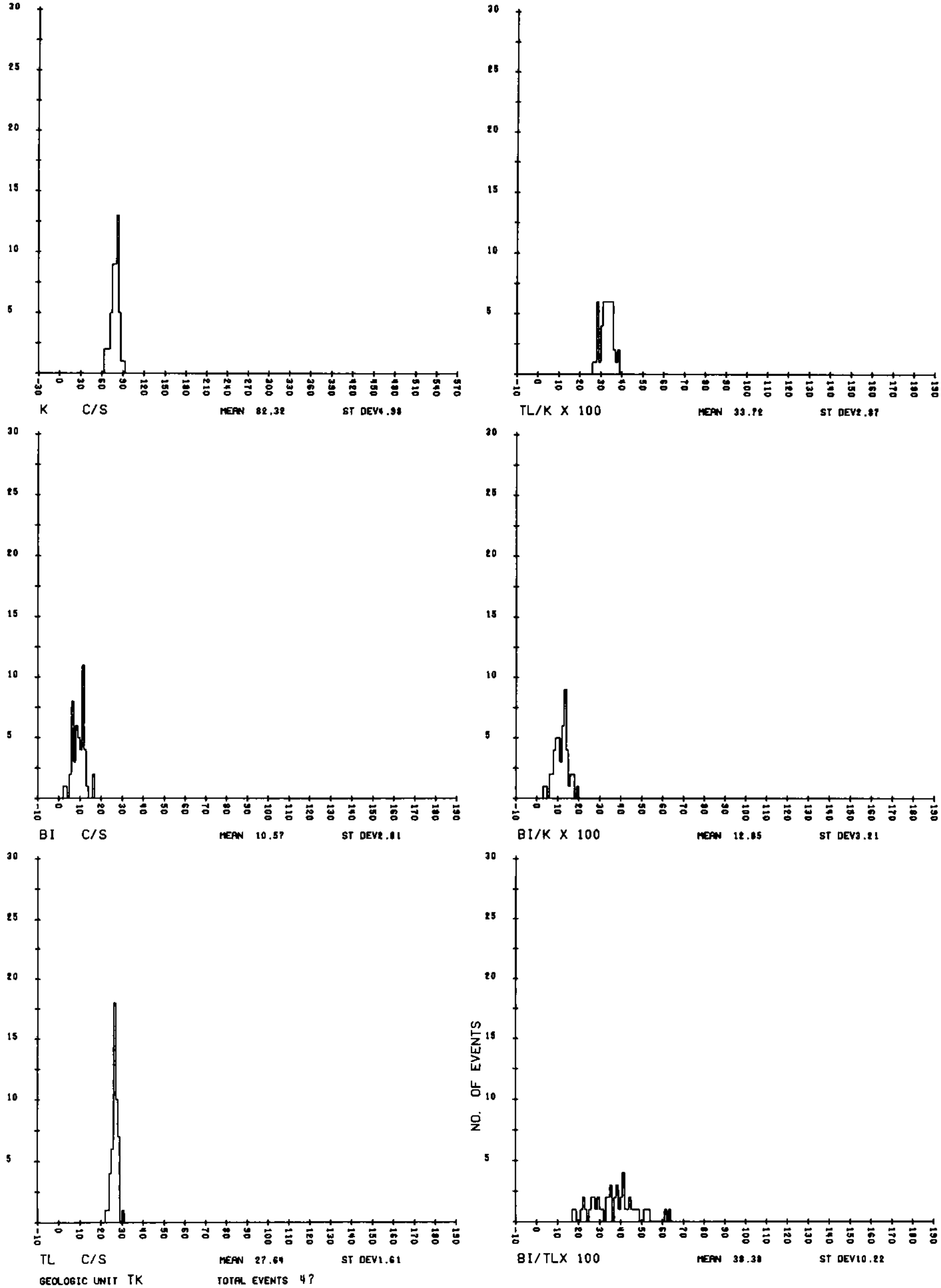
TL C/S MEAN 94.39 ST DEV16.39

GEOLOGIC UNIT T2RT TOTAL EVENTS 109

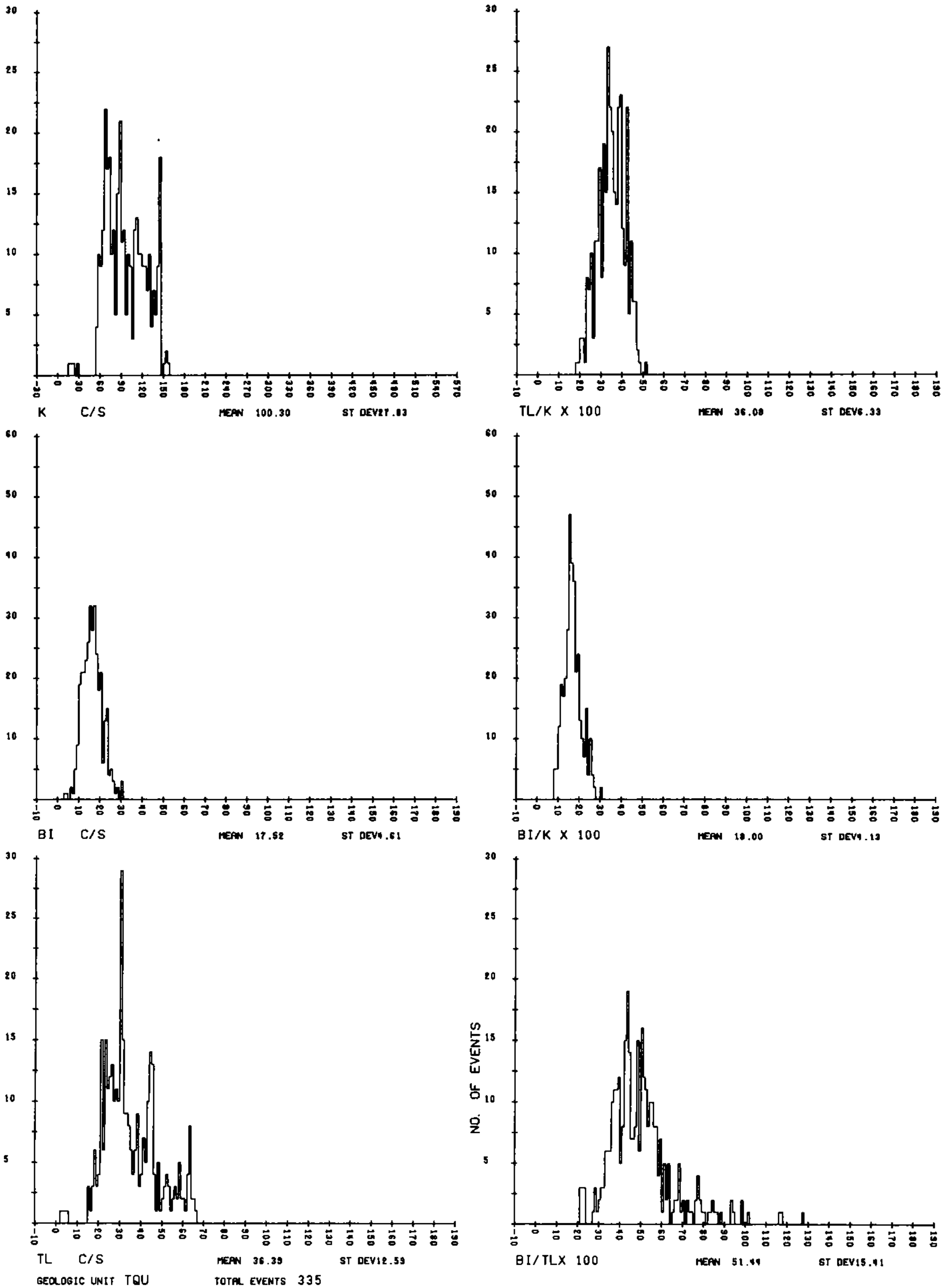


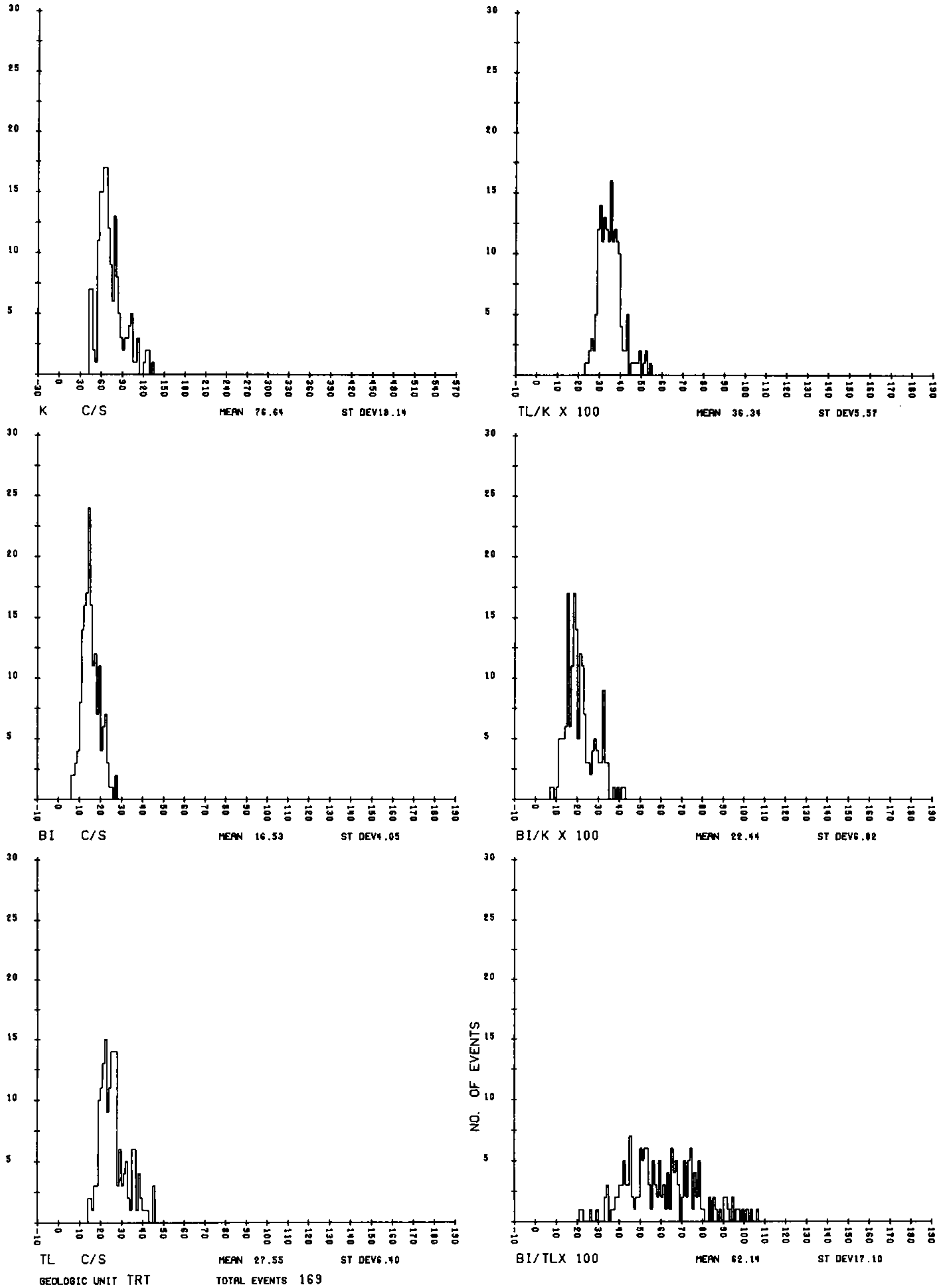
BI/TLX 100 MEAN 35.09 ST DEV5.13


K C/S
MEAN 186.38
ST DEV38.25
TL/K X 100
MEAN 39.60
ST DEV12.84
BI C/S
MEAN 31.28
ST DEV8.05
BI/K X 100
MEAN 16.32
ST DEV3.72
TL C/S
MEAN 71.31
ST DEV21.90
GEOLOGIC UNIT TIG
TOTAL EVENTS 173
NO. OF EVENTS
BI/TLX 100
MEAN 46.34
ST DEV15.20

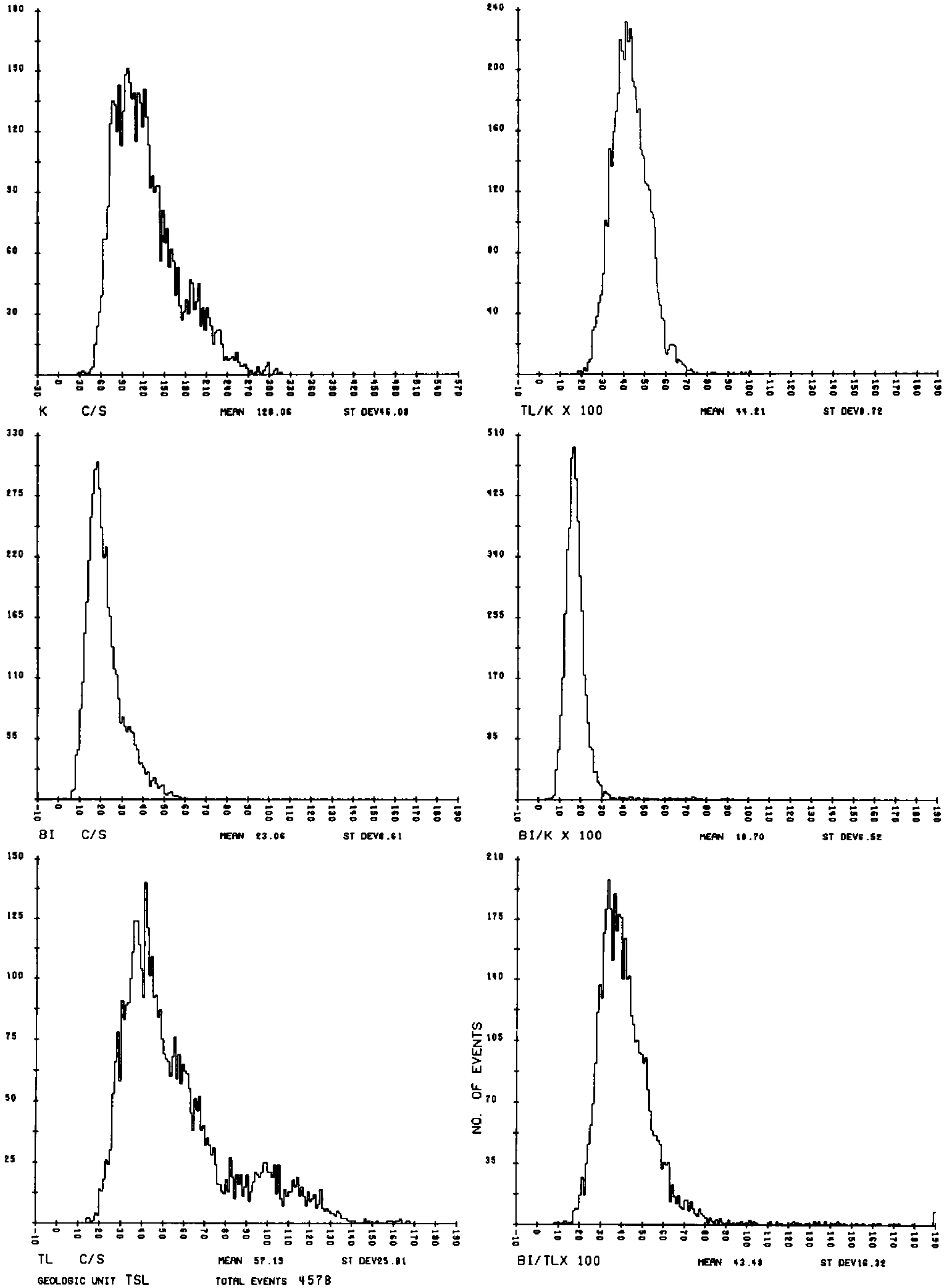


A65 BRIGHAM CITY


K C/S
MEAN 100.30
ST DEV27.83
TL/K X 100
MEAN 36.09
ST DEV6.33
BI C/S
MEAN 17.62
ST DEV4.61
BI/K X 100
MEAN 18.00
ST DEV4.13
TL C/S
MEAN 36.39
ST DEV12.59
BI/TLX 100
MEAN 51.44
ST DEV15.41
NO. OF EVENTS
GEOLOGIC UNIT TQU
TOTAL EVENTS 335



A67 BRIGHAM CITY



A68 BRIGHAM CITY

APPENDIX II

DESCRIPTION OF MAGNETIC TAPES AND LISTINGS

A. DESCRIPTION OF DATA TAPES

A1. General

All data tapes are 9-track, 800 BPI (NRZI), odd parity, EBCDIC code. Each tape contains a gum label giving the survey project name, month and year of survey, tape type, subcontractor name, date tape created, tape reel count, tape recording characteristics, block size in Bytes and location of tape format information.

The general description for each of the tape types is as follows:

Block Number	Description
1	Format Description
2	Tape Identification
3	First Data Block
4	Second Data Block
.	.
.	.
.	Last Data Block
EOF	

A2. Raw Spectral Data Tapes

Block Size (Physical Record): 6600 characters
Logical Record, Data : 1100 characters

1. Format Description Block (Block 1)

The Format Description utilizes 4248 characters. The remaining 2352 characters of this block are blanks.

```
Line                               Character Number
Number  12345678901234567890123456789012345678901234567890123456789012345678901234

1       01 0978  (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODES)
2
3       RAW SPECTRAL DATA TAPE
4
5       FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK ON TAPE)
6
7       ITEM   FORMAT    DESCRIPTION
8       1      A40       QUADRANGLE NAME AS PROJECT IDENTIFICATION
9       2      A20       NAME OF SUBCONTRACTOR
10      3      I4        APPROXIMATE DATE OF SURVEY (MONTH, YEAR)
```

Line Number — Character Number 1234567890123456789012345678901234567890123456789012345678901234567890123456789012

4	I1	AERIAL SYSTEM IDENTIFICATION CODE
5	A20	AIRCRAFT IDENTIFICATION BY TYPE AND FAA NUMBER
6	I3	BFEC CALIBRATION REPORT NUMBER
7	F6.3	4PI SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL PLACES IN SECONDS
8	F6.3	2PI SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL PLACES IN SECONDS
9	I3	NUMBER OF CHANNELS (0-3 MEV) FOR 4PI SYSTEM
10	I3	NUMBER OF CHANNELS (0-3 MEV) FOR 2PI SYSTEM
11	I3	NUMBER OF FLIGHT LINES ON THIS TAPE
12	I4	FIRST FLIGHT LINE NUMBER ON THIS TAPE
13	I6	FIRST RECORD NUMBER OF FIRST FLIGHT LINE
14	I3	JULIAN DATE (DAY OF YEAR) FIRST FLIGHT LINE WAS COLLECTED
15-17	I4,I6,I3	REPEAT OF ITEMS 12-14 FOR SECOND FLIGHT LINE ON THIS TAPE
*	*	*
*	*	*
*	*	*
306-308	I4,I6,I3	REPEAT OF ITEMS 12-14 FOR 99TH FLIGHT LINE ON THIS TAPE

FORMAT FOR RAW SPECTRAL DATA RECORD (THIRD THRU LAST BLOCK ON TAPE)

ITEM	FORMAT	DESCRIPTION
1	I1	AERIAL SYSTEM IDENTIFICATION CODE
2	I4	FLIGHT LINE NUMBER
3	I6	RECORD IDENTIFICATION NUMBER
4	I6	GMT TIME OF DAY (HHMMSS)
5	F8.4	LATITUDE TO FOUR DECIMAL PLACES IN DEGREES
6	F8.4	LONGITUDE TO FOUR DECIMAL PLACES IN DEGREES
7	F6.1	TERRAIN CLEARANCE TO ONE DECIMAL PLACE IN METERS
8	F7.1	TOTAL MAGNETIC FIELD INTENSITY TO ONE DECIMAL PLACE IN GAMMAS
9	A8	SURFACE GEOLOGIC MAP UNIT CODE
10	I4	QUALITY FLAG CODES
11	F4.1	OUTSIDE AIR TEMPERATURE TO ONE DECIMAL PLACE IN DEGREES CELSIUS
12	F5.1	OUTSIDE AIR PRESSURE TO ONE DECIMAL PLACE IN MMHG
13	F5.3	LIVE TIME COUNTING PERIOD TO THREE DECIMAL PLACES IN SECONDS
14	I4	SUMMED RAW OUTPUT FROM COSMIC CHANNELS (3-6 MEV) IN COUNTS
15	I4	RAW OUTPUT FROM CHANNEL 1 IN COUNTS
16	I4	RAW OUTPUT FROM CHANNEL 2 IN COUNTS
*	*	*
*	*	*
*	*	*
270	I4	RAW OUTPUT FROM CHANNEL 256 IN COUNTS
-	-	2352 BLANK CHARACTERS

2. Tape Identification Block (Block 2)

The information and format for this block are indicated in lines 8 through 30 of the Format Description Block A2.1, and 1396 characters are produced. The remaining 5204 characters in this block are blanks.

If fewer than 99 flight lines exist, the unused flight line information, 13 characters per flight line, is filled with 9's through the 99th flight line.

3. Raw Spectral Data Blocks

The information and format for the logical records in these blocks are indicated in lines 36 through 59 of the Format Description Block A2.1. One logical record contains 1100 characters. There are six such logical records per 6600 character physical record or block.

The 2π data logical record is recorded after the corresponding 4π data collection intervals at a frequency dependent on the 2π system data collection interval. For example, if the 4π data collection interval is 1 second and the 2π data collection interval is 10 seconds, then 10 records of 4π data are recorded followed by 1 record of the 2π data which was collected during the preceding 10 seconds. The format for the 2π data is identical to that of the 4π data, except for lines 40 through 49 of the Format Description Block given above. These variables are expressed in the 2π record as all nines in the format specified for I and F fields, and all zeros for A fields.

A3. Single Record Reduced Data Tapes

Block Size (Physical Record): 6900 characters
Logical Record, Data : 138 characters

1. Format Description Block (Block 1)

The Format Description utilizes 6768 characters. The remaining 132 characters of this block are blanks.

```
Line                               Character Number
Number  123456789012345678901234567890123456789012345678901234567890123456789012

1       02  0978  (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODES)
2
3       SINGLE RECORD REDUCED DATA TAPE
4
5       FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK)
6
```

Line Number — Character Number

```
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012

      ITEM   FORMAT    DESCRIPTION
      1      A40       QUADRANGLE NAME AS PROJECT IDENTIFICATION
      2      A20       NAME OF SUBCONTRACTOR
      3      I4        APPROXIMATE DATE OF SURVEY (MONTH, YEAR)
      4      I1        NUMBER OF AERIAL SYSTEMS USED TO COLLECT DATA FOR
                       THIS QUADRANGLE
      5      I1        AERIAL SYSTEM IDENTIFICATION CODE FOR FIRST SYSTEM
      6      A20       AIRCRAFT IDENTIFICATION BY TYPE AND FAA NUMBER FOR
                       FIRST SYSTEM
      7      F6.1      NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
                       TERRESTRIAL POTASSIUM (K-40) TO ONE DECIMAL PLACE
                       IN CPS PER PERCENT K FOR FIRST SYSTEM
      8      F6.1      NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
                       TERRESTRIAL URANIUM (BI-214) TO ONE DECIMAL PLACE
                       IN CPS PER PPM EQUIVALENT U
      9      F6.1      NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
                       TERRESTRIAL THORIUM (TL-208) TO ONE DECIMAL PLACE
                       IN CPS PER PPM EQUIVALENT TH
      10     I6        BLANK FIELD (999999)
      11     F6.3      4PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL
                       PLACES IN SECONDS FOR FIRST SYSTEM
      12     F6.3      2PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL
                       PLACES IN SECONDS FOR FIRST SYSTEM
      13     I3        NUMBER OF CHANNELS (0-3 MEV) IN 4PI SYSTEM FOR FIRST
                       AERIAL SYSTEM
      14     I3        NUMBER OF CHANNELS (0-3 MEV) IN 2PI SYSTEM FOR FIRST
                       AERIAL SYSTEM
      15-24  (SAME)    REPEAT OF ITEMS 5-14 FOR SECOND AERIAL SYSTEM
      *      *                             *
      *      *                             *
      *      *                             *
      85-94  (SAME)    REPEAT OF ITEMS 5-14 FOR NINTH AERIAL SYSTEM
      95     I3        NUMBER OF FLIGHT LINES ON THIS TAPE
      96     I4        FIRST FLIGHT LINE NUMBER ON THIS TAPE
      97     I6        FIRST RECORD NUMBER OF FIRST FLIGHT LINE
      98     I3        JULIAN DATE (DAY OF YEAR) FIRST FLIGHT-LINE DATA WAS
                       COLLECTED
      99-101 I4,I6,I3  REPEAT OF ITEMS 96-98 FOR SECOND FLIGHT LINE ON THIS
                       TAPE
      *      *                             *
      *      *                             *
      *      *                             *
     390-392 I4,I6,I3  REPEAT OF ITEMS 96-98 FOR 99TH FLIGHT LINE ON THIS
                       TAPE

     FORMAT FOR SINGLE RECORD REDUCED DATA RECORD (THIRD THRU LAST BLOCK)

     ITEM    FORMAT    DESCRIPTION
      1      I1        AERIAL SYSTEM IDENTIFICATION CODE
      2      I4        FLIGHT LINE NUMBER
      3      I6        RECORD IDENTIFICATION NUMBER
      4      I6        GMT TIME OF DAY (HHMMSS)
      5      F8.4      LATITUDE TO FOUR DECIMAL PLACES IN DEGREES
```

Line Number	Character Number 123456789012345678901234567890123456789012345678901234567890123456789012		
60	6	F8.4	LONGITUDE TO FOUR DECIMAL PLACES IN DEGREES
61	7	F6.1	TERRAIN CLEARANCE TO ONE DECIMAL PLACE IN METERS
62	8	F7.1	RESIDUAL (IGRF REMOVED) MAGNETIC FIELD INTENSITY
63			TO ONE DECIMAL PLACE IN GAMMAS
64	9	A8	SURFACE GEOLOGIC MAP UNIT CODE
65	10	I4	QUALITY FLAG CODES
66	11	F6.1	APPARENT CONCENTRATION OF TERRESTRIAL POTASSIUM
67			(K-40) TO ONE DECIMAL PLACE IN PERCENT K
68	12	F4.1	UNCERTAINTY IN TERRESTRIAL POTASSIUM TO ONE DECIMAL
69			PLACE IN PERCENT K
70	13	F6.1	APPARENT CONCENTRATION OF TERRESTRIAL URANIUM
71			(BI-214) TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
72	14	F4.1	UNCERTAINTY IN TERRESTRIAL URANIUM TO ONE DECIMAL
73			PLACE IN PPM EQUIVALENT U
74	15	F6.1	APPARENT CONCENTRATION OF TERRESTRIAL THORIUM
75			(TL-208) TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH
76	16	F4.1	UNCERTAINTY IN TERRESTRIAL THORIUM TO ONE DECIMAL
77			PLACE IN PPM EQUIVALENT TH
78	17	F6.1	URANIUM-TO-THORIUM RATIO TO ONE DECIMAL PLACE IN
79			PPM EQUIVALENT U PER PPM EQUIVALENT TH
80	18	F6.1	URANIUM-TO-POTASSIUM RATIO TO ONE DECIMAL PLACE IN
81			PPM EQUIVALENT U PER PERCENT K
82	19	F6.1	THORIUM-TO-POTASSIUM RATIO TO ONE DECIMAL PLACE IN
83			PPM EQUIVALENT TH PER PERCENT K
84	20	F8.1	GROSS GAMMA (0.4-3.0 MEV) COUNT RATE TO ONE DECIMAL
85			PLACE IN COUNTS PER SECOND
86	21	F6.1	UNCERTAINTY IN GROSS GAMMA COUNT RATE TO ONE DECIMAL
87			PLACE IN COUNTS PER SECOND
88	22	F5.1	ATMOSPHERIC BI-214 4PI CORRECTION TO ONE DECIMAL
89			PLACE IN PPM EQUIVALENT U
90	23	F4.1	UNCERTAINTY IN ATMOSPHERIC BI-214 4PI CORRECTION
91			TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
92	24	F4.1	OUTSIDE AIR TEMPERATURE TO ONE DECIMAL PLACE IN
93			DEGREES CELSIUS
94	25	F5.1	OUTSIDE AIR PRESSURE TO ONE DECIMAL PLACE IN MMHG

2. Tape Identification Block (Block 2)

The information and format for this block are indicated in lines 8 through 49 of the Format Description Block A3.1, and 1922 characters are produced. The remaining 4978 characters of this block are blanks.

If less than nine aerial systems are used, the space allocated for additional systems is filled with 9's in the format specified for each item using I and F fields, and with zeros for A fields.

Similarly, if fewer than 99 flight lines exist, the unused flight line information, 13 characters per flight line, is filled with 9's through the 99th flight line.

3. <u>Single Record Reduced Data Blocks</u>

The information and format for the logical records in these blocks are indicated in lines 55 through 94 of the Format Description Block A3.1. One logical record contains 138 characters. There are 50 such logical records per 6900 character physical record or block.

The data appearing in locations specified by lines 68, 72, 76, 86 and 90 of the Format Description Block A3.1 are 9's in the format specified in each case.

A4. Statistical Analysis Data Tapes

Block Size (Physical Record): 8000 characters
Logical Record, Data : 160 characters

1. <u>Format Description Block (Block 1)</u>

The Format Description utilizes 7560 characters. The remaining 440 characters are blanks.

Line Number	Character Number 12345678901234567890123456789012345678901234567890123456789012		
1	03 0978 (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODES)		
2			
3	STATISTICAL ANALYSIS DATA TAPE		
4			
5	FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK)		
6			
7	ITEM	FORMAT	DESCRIPTION
8	1	A40	QUADRANGLE NAME AS PROJECT IDENTIFICATION
9	2	A20	NAME OF SUBCONTRACTOR
10	3	I4	APPROXIMATE DATE OF SURVEY (MONTH, YEAR)
11	4	I1	NUMBER OF AERIAL SYSTEMS USED TO COLLECT DATA FOR
12			THIS QUADRANGLE
13	5	I1	AERIAL SYSTEM IDENTIFICATION CODE FOR FIRST SYSTEM
14	6	A20	AIRCRAFT IDENTIFICATION BY TYPE AND FAA NUMBER FOR
15			FIRST SYSTEM
16	7	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
17			TERRESTRIAL POTASSIUM (K-40) TO ONE DECIMAL PLACE
18			IN CPS PER PERCENT K
19	8	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
20			TERRESTRIAL URANIUM (BI-214) TO ONE DECIMAL PLACE
21			IN CPS PER PPM EQUIVALENT U
22	9	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
23			TERRESTRIAL THORIUM (TL-208) TO ONE DECIMAL PLACE
24			IN CPS PER PPM EQUIVALENT TH
25	10	I6	BLANK FIELD (999999)
26	11	F6.3	4PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL
27			PLACES IN SECONDS FOR FIRST SYSTEM
28	12	F6.3	2PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL
29			PLACES IN SECONDS FOR FIRST SYSTEM

```
Line                                Character Number
Number   1234567890123456789012345678901234567890123456789012345678901234567890123456789012

         13      I3          NUMBER OF CHANNELS (0-3 MEV) IN 4PI SYSTEM FOR FIRST
                             AERIAL SYSTEM
         14      I3          NUMBER OF CHANNELS (0-3 MEV) IN 2PI SYSTEM FOR FIRST
                             AERIAL SYSTEM
         15-24   (SAME)      REPEAT OF ITEMS 5-14 FOR SECOND AERIAL SYSTEM
         *       *                                  *
         *       *                                  *
         *       *                                  *
         85-94   (SAME)      REPEAT OF ITEMS 5-14 FOR NINTH AERIAL SYSTEM
         95      I3          NUMBER OF FLIGHT LINES ON THIS TAPE
         96      I4          FIRST FLIGHT LINE NUMBER ON THIS TAPE
         97      I6          FIRST RECORD NUMBER OF FIRST FLIGHT LINE
         98      I3          JULIAN DATE (DAY OF YEAR) FIRST FLIGHT LINE DATA WAS
                             COLLECTED
        99-101   I4,I6,I3    REPEAT OF ITEMS 96-98 FOR SECOND FLIGHT LINE ON THIS
                             TAPE
         *       *                                  *
         *       *                                  *
         *       *                                  *
        390-392  I4,I6,I3    REPEAT OF ITEMS 96-98 FOR 99TH FLIGHT LINE ON THIS
                             TAPE

         FORMAT FOR STATISTICAL ANALYSIS DATA RECORD (THIRD THRU LAST BLOCK)

         ITEM    FORMAT      DESCRIPTION
         1       I1          AERIAL SYSTEM IDENTIFICATION CODE
         2       I4          FLIGHT LINE NUMBER
         3       I6          RECORD IDENTIFICATION NUMBER
         4       I6          GMT TIME OF DAY (HHMMSS)
         5       F8.4        LATITUDE TO FOUR DECIMAL PLACES IN DEGREES
         6       F8.4        LONGITUDE TO FOUR DECIMAL PLACES IN DEGREES
         7       F6.1        TERRAIN CLEARANCE TO ONE DECIMAL PLACE IN METERS
         8       F7.1        RESIDUAL (IGRF REMOVED) MAGNETIC FIELD INTENSITY
                             TO ONE DECIMAL PLACE IN GAMMAS
         9       A8          SURFACE GEOLOGIC MAP UNIT CODE
         10      I5          QUALITY FLAG CODES
         11      F6.1        AVERAGED CONCENTRATION OF TERRESTRIAL POTASSIUM
                             (K-40) TO ONE DECIMAL PLACE IN PERCENT K
         12      F4.1        UNCERTAINTY IN TERRESTRIAL POTASSIUM TO ONE DECIMAL
                             PLACE IN PERCENT K
         13      F5.1        POTASSIUM STANDARD DEVIATION FROM THE MEAN TO ONE
                             DECIMAL PLACE AND ALGEBRAICALLY SIGNED
         14      F6.1        AVERAGED CONCENTRATION OF TERRESTRIAL URANIUM
                             (BI-214) TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
         15      F4.1        UNCERTAINTY IN TERRESTRIAL URANIUM TO ONE DECIMAL
                             PLACE IN PPM EQUIVALENT U
         16      F5.1        URANIUM STANDARD DEVIATION FROM THE MEAN TO ONE
                             DECIMAL PLACE AND ALGEBRAICALLY SIGNED
         17      F6.1        AVERAGED CONCENTRATION OF TERRESTRIAL THORIUM
                             (TL-208) TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH
         18      F4.1        UNCERTAINTY IN TERRESTRIAL THORIUM TO ONE DECIMAL
                             PLACE IN PPM EQUIVALENT TH
```

Line Number	Character Number 12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012		
82	19	F5.1	THORIUM STANDARD DEVIATION FROM THE MEAN TO ONE
83			DECIMAL PLACE AND ALGEBRAICALLY SIGNED
84	20	F8.1	GROSS GAMMA (0.4-3.0 MEV) COUNT RATE TO ONE DECIMAL
85			PLACE IN COUNTS PER SECOND
86	21	F6.1	UNCERTAINTY IN GROSS GAMMA COUNT RATE TO ONE DECIMAL
87			PLACE IN COUNTS PER SECOND
88	22	F5.1	ATMOSPHERIC BI-214 4PI CORRECTION TO ONE DECIMAL
89			PLACE IN PPM EQUIVALENT U
90	23	F4.1	UNCERTAINTY IN ATMOSPHERIC BI-214 4PI CORRECTION
91			TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
92	24	F6.1	AVERAGED URANIUM-TO-THORIUM RATIO TO ONE DECIMAL
93			PLACE IN PPM EQUIVALENT U PER PPM EQUIVALENT TH
94	25	F5.1	URANIUM-TO-THORIUM RATIO STANDARD DEVIATION FROM THE
95			MEAN TO ONE DECIMAL PLACE AND ALGEBRAICALLY SIGNED
96	26	F6.1	AVERAGED URANIUM-TO-POTASSIUM RATIO TO ONE DECIMAL
97			PLACE IN PPM EQUIVALENT U PER PERCENT K
98	27	F5.1	URANIUM-TO-POTASSIUM RATIO STANDARD DEVIATION FROM
99			THE MEAN TO ONE DECIMAL PLACE AND ALGEBRAICALLY SIGNED
100			SIGNED
101	28	F6.1	AVERAGED THORIUM-TO-POTASSIUM RATIO TO ONE DECIMAL
102			PLACE IN PPM EQUIVALENT TH PER PERCENT K
103	29	F5.1	THORIUM-TO-POTASSIUM RATIO STANDARD DEVIATION FROM
104			THE MEAN TO ONE DECIMAL PLACE AND ALGEBRAICALLY
105			SIGNED

2. Tape Identification Block (Block 2)

The information and format for this block are indicated in lines 8 through 49 of the Format Description Block A4.1, and 1922 characters are produced. The remaining 6078 characters of this block are blanks.

If less than nine aerial systems are used, the space allocated for additional systems is filled with 9's in the format specified for each item using I and F fields, and with zeros for A fields.

Similarly, if fewer than 99 flight lines exist, the unused flight line information, 13 characters per flight line, is filled with 9's through the 99th flight line.

3. Statistical Analysis Data Blocks

The information and format for the logical records in these blocks are indicated in lines 55 through 103 of the Format Description Block A4.1. One logical record contains 160 characters. There are 50 such logical records per 8000 character physical record or block.

The data appearing in locations specified by lines 68, 74, 80, 86 and 90 of the Format Description Block A4.1 are 9's in the format specified in each case.

A5. Magnetic Data Tapes

Block Size (Physical Record): 8000 characters
Logical Record (Data) : 80 characters

1. Format Description Block (Block 1)

The Format Description utilizes 3384 characters. The remaining 4616 characters are blanks.

```
Line                          Character Number
Number  123456789012345678901234567890123456789012345678901234567890123456789012

1       04  0978  (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODES)
2
3       MAGNETIC DATA TAPE
4
5       FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK)
6
7       ITEM    FORMAT    DESCRIPTION
8       1       A40       QUADRANGLE NAME AS PROJECT IDENTIFICATION
9       2       A20       NAME OF SUBCONTRACTOR
10      3       I4        APPROXIMATE DATE OF SURVEY (MONTH, YEAR)
11      4       I3        NUMBER OF FLIGHT LINES ON THIS TAPE
12      5       I4        FIRST FLIGHT LINE ON THIS TAPE
13      6       I6        FIRST RECORD NUMBER OF FIRST FLIGHT LINE
14      7       I3        JULIAN DATE (DAY OF YEAR) FIRST FLIGHT LINE DATA WAS
15                        COLLECTED
16      8       F8.4      LATITUDE OF GROUND BASE STATION TO FOUR DECIMAL
17                        PLACES IN DEGREES FOR FIRST FLIGHT LINE
18      9       F8.4      LONGITUDE OF GROUND BASE STATION TO FOUR DECIMAL
19                        PLACES IN DEGREES FOR FIRST FLIGHT LINE
20      10-14   (SAME)    REPEAT OF ITEMS 5-9 FOR SECOND FLIGHT LINE ON THIS
21                        TAPE
22      *       *                             *
23      *       *                             *
24      *       *                             *
25     495-499  (SAME)    REPEAT OF ITEMS 5-9 FOR 99TH FLIGHT LINE ON THIS
26                        TAPE
27
28      FORMAT FOR MAGNETIC DATA RECORD (THIRD THRU LAST BLOCK)
29
30      ITEM    FORMAT    DESCRIPTION
31      1       I1        AERIAL SYSTEM IDENTIFICATION CODE
32      2       I4        FLIGHT LINE NUMBER
33      3       I6        RECORD IDENTIFICATION NUMBER
34      4       I6        GMT TIME OF DAY (HHMMSS)
35      5       F8.4      LATITUDE TO FOUR DECIMAL PLACES IN DEGREES
36      6       F8.4      LONGITUDE TO FOUR DECIMAL PLACES IN DEGREES
37      7       F6.1      TERRAIN CLEARANCE TO ONE DECIMAL PLACE IN METERS
38      8       F5.1      OUTSIDE AIR PRESSURE TO ONE DECIMAL PLACE IN MMHG
39      9       A8        SURFACE GEOLOGIC MAP UNIT CODE
40      10      F7.1      TOTAL MAGNETIC FIELD INTENSITY TO ONE DECIMAL PLACE
41                        IN GAMMAS
42      11      F7.1      RESIDUAL (IGRF REMOVED) MAGNETIC FIELD INTENSITY
```

```
Line                              Character Number
Number  12345678901234567890123456789012345678901234567890123456789012345678901234567890

44      12     F7.1      DIURNAL MAGNETIC INTENSITY VARIATION TO ONE DECIMAL
45                       PLACE IN GAMMAS
46      13     F7.1      MAGNETIC DEPTH-TO-BASEMENT TO ONE DECIMAL PLACE
47                       IN METERS (IF REQUIRED)
```

2. Tape Identification Block (Block 2)

The information and format for this block are indicated in lines 8 through 25 of the Format Description Block A5.1, and 2938 characters are produced. The remaining 5062 characters of this block are blanks.

If fewer than 99 flight lines exist, the unused flight line information, 29 characters per flight line, is filled with 9's through the 99th flight line in the format indicated.

3. Magnetic Data Blocks

The information and format for the logical records in these blocks are indicated in lines 31 through 46 of the Format Description Block A5.1. One logical record contains 80 characters. There are 100 such logical records per 8000 character physical record or block.

If the magnetic depth-to-basement is not required, this item is expressed as 99999.9.

A6. Statistical Analysis Summary Tapes

Block Size (Physical Record): 7000 characters
Logical Record (Data)   : 140 characters

1. Format Description Block (Block 1)

The Format Description utilizes 4320 characters. The remaining 2680 characters are blanks.

```
Line                              Character Number
Number  12345678901234567890123456789012345678901234567890123456789012345678901234567890

1       05  0978  (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODE)
2
3       STATISTICAL ANALYSIS SUMMARY TAPE (OR FILE)
4
5       FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK)
6
7       ITEM   FORMAT    DESCRIPTION
8       1      A40       QUADRANGLE NAME AS PROJECT IDENTIFICATION
9       2      A20       NAME OF SUBCONTRACTOR
10      3      I4        APPROXIMATE DATE OF SURVEY (MONTH, YEAR)
11      4      I6        NUMBER OF GEOLOGIC MAP UNITS USED FOR THIS
```

```
                                 Character Number
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012

                QUADRANGLE

FORMAT FOR STATISTICAL ANALYSIS SUMMARY DATA RECORD (THIRD THRU LAST
BLOCK)

ITEM   FORMAT   DESCRIPTION
1      A8       SURFACE GEOLOGIC MAP UNIT IDENTIFYING CODE
2      I6       TOTAL RECORDS FOR GEOLOGIC MAP UNIT
3      I6       NUMBER OF POTASSIUM RECORDS COMPUTED FOR GEOLOGIC
                UNIT
4      F6.1     POTASSIUM CONCENTRATION MEAN TO ONE DECIMAL
                PLACE IN PERCENT K
5      F6.1     POTASSIUM CONCENTRATION STANDARD DEVIATION TO ONE
                DECIMAL PLACE IN PERCENT K
6      A3       POTASSIUM CONCENTRATION DISTRIBUTION CODE
7      I6       NUMBER OF URANIUM RECORDS COMPUTED FOR GEOLOGIC UNIT
8      F6.1     URANIUM CONCENTRATION MEAN TO ONE DECIMAL PLACE
                IN PPM EQUIVALENT U
9      F6.1     URANIUM CONCENTRATION STANDARD DEVIATION TO ONE
                DECIMAL PLACE IN PPM EQUIVALENT U
10     A3       URANIUM CONCENTRATION DISTRIBUTION CODE
11     I6       NUMBER OF THORIUM RECORDS COMPUTED FOR GEOLOGIC UNIT
12     F6.1     THORIUM CONCENTRATION MEAN TO ONE DECIMAL PLACE IN
                PPM EQUIVALENT TH
13     F6.1     THORIUM CONCENTRATION STANDARD DEVIATION TO ONE
                DECIMAL PLACE IN PPM EQUIVALENT TH
14     A3       THORIUM CONCENTRATION DISTRIBUTION CODE
15     I6       NUMBER OF URANIUM-TO-THORIUM RATIO RECORDS COMPUTED
                FOR GEOLOGIC UNIT
16     F6.1     URANIUM-TO-THORIUM RATIO MEAN TO ONE DECIMAL PLACE
                IN PPM EQUIVALENT U PER PPM EQUIVALENT TH
17     F6.1     URANIUM-TO-THORIUM RATIO STANDARD DEVIATION TO ONE
                DECIMAL PLACE IN PPM EQUIVALENT U PER PPM EQUIVALENT
                TH
18     A3       URANIUM-TO-THORIUM RATIO DISTRIBUTION CODE
19     I6       NUMBER OF URANIUM-TO-POTASSIUM RATIO RECORDS
                COMPUTED FOR GEOLOGIC UNIT
20     F6.1     URANIUM-TO-POTASSIUM RATIO MEAN TO ONE DECIMAL PLACE
                IN PPM EQUIVALENT U PER PERCENT K
21     F6.1     URANIUM-TO-POTASSIUM RATIO STANDARD DEVIATION TO ONE
                DECIMAL PLACE IN PPM EQUIVALENT U PER PERCENT K
22     A3       URANIUM-TO-POTASSIUM RATIO DISTRIBUTION CODE
23     I6       NUMBER OF THORIUM-TO-POTASSIUM RATIO RECORDS
                COMPUTED FOR GEOLOGIC UNIT
24     F6.1     THORIUM-TO-POTASSIUM RATIO MEAN TO ONE DECIMAL PLACE
                IN PPM EQUIVALENT TH PER PERCENT K
25     F6.1     THORIUM-TO-POTASSIUM RATIO STANDARD DEVIATION TO ONE
                DECIMAL PLACE IN PPM EQUIVALENT TH PER PERCENT K
26     A3       THORIUM-TO-POTASSIUM RATIO DISTRIBUTION CODE
```

2. Tape Identification Block (Block 2)

The information and format for this block are indicated in lines 8 through 11 of the Format Description Block A6.1, and 70 characters are produced. The remaining 6930 characters of this block are blanks.

3. Statistical Analysis Summary Data Blocks

The information and format for the logical records in these blocks are indicated in lines 18 through 60 of the Format Description Block A6.1. One logical record contains 140 characters. There are 50 such logical records per 7000 character physical record or block.

B. DESCRIPTION OF LISTINGS

B1. Single record reduced data listings: include the following information on Microfiche:

ITEM	DESCRIPTION
REC	Sequential record number
Lat	Location Y in latitude
Long	Location X in longitude
RMag	Residual magnetic field, gammas
Alt	Surface altitude
GEO UNIT	Geologic Type
AKUT	A=Altitude; K=Potassium; U=Uranium T=Thorium - Results of statistical adequacy test
COS	Cosmic c/s
BiAir	Airborne ^{214}Bi, 4π data
GC	Gross count, .4 MeV - 2.8 MeV
Tℓ	^{208}Tℓ c/s
Bi	^{214}Bi c/s
K	^{40}K c/s
BI:Tℓ	Ratio
BI:k	Ratio
Tℓ:K	Ratio
TEMP	Outside Air Temperature (^{o}C)
BP	Atmospheric Pressure (In. Hg)

B2. Averaged record data listings: include the following information on Microfiche:

ITEM	DESCRIPTION
REC	Sequential Record number
GEO UNIT	Geologic type
AKUT	A=Altitude; K=Potassium; U=Uranium; T=Thorium - Results of statistical adequacy test
Long	Longitude of X location of geologic type
Lat	latitude of Y location of geologic type
RMag	Residual magnetic field, gammas
COS	Cosmic, 4π
BiAir	Atmospheric Bi, 4π
GC	Gross count, c/s

ITEM	DESCRIPTION
Tℓ	Tℓ value, c/s
Rank	Tℓ standard deviation rank
Bi	Bi value, c/s
Rank	Bi standard deviation rank
K	K value, c/s
Rank	K standard deviation rank
Bi/Tℓ	Ratio value
Rank	Bi/Tℓ standard deviation rank
Bi/K	Ratio value
Rank	Bi/K standard deviation rank
Tℓ/K	Ratio value
Rank	Tℓ/K standard deviation rank

1 GEODATA INT. INC. SINGLE REC LISTING BRIGHAM CITY MAP LINE 1W

REC	LAT	LONG	RMAG	ALT	GEOUNT	A	K	U	T	COS	BIAIR	GC	TL	BI	K	BI:TL	BI:K	TL:K	TEMP	BP
1	41.0208	113.9808	-233.1	368	QAG	0	0	1	0	19	3.2	734	20	4	62	0.200	0.065	0.323	22.4	23.05
2	41.0208	113.9803	-233.2	369	QAG	0	0	0	0	26	3.2	968	26	10	78	0.385	0.128	0.333	22.3	23.05
3	41.0208	113.9798	-167.2	371	QAG	0	0	0	0	31	3.2	1064	28	14	77	0.500	0.182	0.364	22.2	23.07
4	41.0208	113.9793	-134.2	382	QAG	0	0	0	0	45	3.2	1007	26	10	87	0.385	0.115	0.299	22.1	23.06
5	41.0208	113.9787	-84.6	397	QAG	0	0	0	0	29	3.2	1110	24	20	88	0.833	0.227	0.273	22.0	23.07
6	41.0208	113.9782	-234.8	379	QAG	0	0	0	0	34	3.2	1118	38	18	72	0.474	0.250	0.528	21.9	23.07
7	41.0208	113.9777	-235.2	365	CAG	0	0	0	0	26	3.2	1165	30	18	97	0.600	0.186	0.309	21.8	23.07
8	41.0208	113.9772	-235.2	349	QAG	0	0	0	0	22	3.2	1209	40	15	96	0.375	0.156	0.417	21.9	23.08
9	41.0208	113.9767	-235.4	337	QAG	0	0	0	0	36	3.2	1168	32	17	101	0.531	0.168	0.317	21.8	23.09
10	41.0208	113.9762	-235.6	328	QAG	0	0	0	0	28	3.2	1195	35	12	91	0.343	0.132	0.385	21.7	23.09
11	41.0208	113.9756	-235.5	322	QAG	0	0	0	0	18	3.2	1230	36	22	90	0.611	0.244	0.400	21.8	23.09
12	41.0208	113.9751	-235.1	321	QAG	0	0	0	0	36	3.2	1236	36	14	91	0.389	0.154	0.396	21.7	23.10
13	41.0208	113.9746	-231.5	319	QAG	0	0	0	0	39	3.2	1204	38	23	76	0.605	0.303	0.500	21.7	23.09
14	41.0208	113.9741	-233.9	320	QAG	0	0	0	0	30	3.2	1158	28	12	94	0.429	0.128	0.298	21.6	23.09
15	41.0208	113.9736	-234.6	330	QAG	0	0	0	0	39	3.2	1173	34	18	90	0.529	0.200	0.378	21.5	23.09
16	41.0208	113.9730	-235.2	338	QAG	0	0	0	0	25	3.2	1172	37	15	82	0.405	0.183	0.451	21.4	23.10
17	41.0208	113.9725	-235.7	343	QAG	0	0	0	0	34	3.2	1172	30	19	78	0.633	0.244	0.385	21.3	23.10
18	41.0208	113.9720	-235.3	343	QAG	0	0	0	0	35	3.2	1116	32	8	77	0.250	0.104	0.416	21.2	23.13
19	41.0207	113.9715	-236.1	351	QAG	0	0	0	0	29	3.2	1178	23	18	112	0.783	0.161	0.205	21.1	23.12
20	41.0207	113.9710	-236.9	357	QAG	0	0	0	0	33	3.2	1217	42	12	94	0.286	0.128	0.447	21.0	23.12
21	41.0207	113.9705	-238.3	356	QAG	0	0	0	0	25	3.3	1238	39	16	92	0.410	0.174	0.424	21.1	23.12
22	41.0208	113.9699	-239.4	360	QAG	0	0	0	0	34	3.3	1247	42	23	68	0.548	0.338	0.618	21.0	23.14
23	41.0208	113.9694	-241.0	362	CAG	0	0	0	0	32	3.3	1355	49	13	95	0.265	0.137	0.516	20.9	23.14
24	41.0208	113.9689	-241.3	364	QAG	0	0	0	0	24	3.3	1303	46	16	109	0.348	0.147	0.422	21.0	23.12
25	41.0208	113.9684	-242.3	372	QAG	0	0	0	0	29	3.3	1415	36	20	104	0.556	0.192	0.346	20.9	23.12
26	41.0208	113.9679	-243.9	377	QAG	0	0	0	0	29	3.3	1511	55	19	128	0.345	0.148	0.430	20.8	23.14
27	41.0208	113.9674	-245.5	377	QAG	0	0	0	0	26	3.3	1587	62	20	127	0.323	0.157	0.488	20.9	23.14
28	41.0208	113.9669	-248.9	378	QAG	0	0	0	0	35	3.3	1570	55	17	142	0.309	0.120	0.387	20.8	23.12
29	41.0208	113.9664	-249.3	366	QAG	0	0	0	0	29	3.3	1548	61	26	121	0.426	0.215	0.504	20.7	23.12
30	41.0208	113.9658	-250.2	365	QAG	0	0	0	0	31	3.3	1531	58	11	137	0.190	0.080	0.423	20.6	23.13
31	41.0208	113.9653	-251.0	367	QAG	0	0	0	0	27	3.2	1418	43	30	112	0.698	0.268	0.384	20.6	23.13
32	41.0208	113.9648	-252.1	369	QAG	0	0	0	0	28	3.2	1430	44	20	129	0.455	0.155	0.341	20.5	23.14
33	41.0208	113.9643	-254.8	365	QAG	0	0	0	0	29	3.2	1362	30	18	124	0.600	0.145	0.242	20.4	23.14
34	41.0208	113.9638	-256.9	357	QAG	0	0	0	0	22	3.2	1317	30	26	112	0.867	0.232	0.268	20.5	23.14
35	41.0208	113.9633	-257.5	361	QAG	0	0	0	0	25	3.2	1224	27	22	93	0.815	0.237	0.290	20.6	23.15
36	41.0208	113.9628	-258.6	362	QAG	0	0	0	0	25	3.2	1212	23	15	112	0.652	0.134	0.205	20.6	23.15
37	41.0208	113.9623	-258.7	367	QAG	0	0	0	0	20	3.2	1177	40	16	97	0.400	0.165	0.412	20.7	23.13
38	41.0208	113.9617	-258.8	372	QAG	0	0	0	0	30	3.2	1041	24	10	86	0.417	0.116	0.279	20.6	23.14
39	41.0208	113.9612	-258.6	375	QAG	0	0	0	0	24	3.2	968	26	8	79	0.308	0.101	0.329	20.7	23.14
40	41.0208	113.9607	-257.9	374	QLTG	0	0	0	0	35	3.2	923	17	17	76	1.000	0.224	0.224	20.6	23.13
41	41.0208	113.9602	-258.3	371	QLTG	0	0	0	0	26	3.2	820	23	13	67	0.565	0.194	0.343	20.6	23.16
42	41.0209	113.9597	-257.5	366	QLTG	0	0	0	0	21	3.2	803	16	6	72	0.375	0.083	0.222	20.6	23.14
43	41.0209	113.9592	-254.9	362	QLTG	0	0	0	0	22	3.2	774	15	7	60	0.467	0.117	0.250	20.7	23.13
44	41.0209	113.9587	-254.5	359	QLTG	0	0	1	0	21	3.2	693	11	3	47	0.273	0.064	0.234	20.8	23.13
45	41.0209	113.9582	-253.4	356	QLTG	0	0	0	0	24	3.2	625	16	6	49	0.375	0.122	0.327	20.7	23.13
46	41.0209	113.9576	-252.0	357	QLTG	0	0	0	0	20	3.2	582	15	7	38	0.467	0.184	0.395	20.8	23.12
47	41.0209	113.9571	-251.3	358	QLTG	0	0	1	0	39	3.2	584	6	4	27	0.667	0.148	0.222	20.7	23.13
48	41.0209	113.9566	-250.2	359	QLTG	0	0	1	0	20	3.2	648	21	4	40	0.190	0.100	0.525	20.8	23.13
49	41.0209	113.9561	-248.1	356	QLTG	0	0	0	0	30	3.2	730	16	8	41	0.500	0.195	0.390	20.7	23.14
50	41.0209	113.9556	-248.2	348	QLCS	0	0	0	0	31	3.2	815	12	21	46	1.750	0.457	0.261	20.6	23.14
51	41.0209	113.9551	-247.4	339	QLCS	0	0	0	0	28	0.6	860	13	20	59	1.538	0.339	0.220	20.6	23.16
52	41.0209	113.9546	-246.8	340	QLCS	0	0	0	0	21	0.6	958	29	22	66	0.759	0.333	0.439	20.6	23.14
53	41.0209	113.9541	-245.6	339	QLCS	0	0	0	0	27	0.6	1028	15	25	79	1.667	0.316	0.190	20.6	23.15
54	41.0209	113.9535	-245.6	333	QLCS	0	0	0	0	27	0.6	1064	32	18	67	0.563	0.269	0.478	20.5	23.15
REC	LAT	LONG	RMAG	ALT	GEOUNT	A	K	U	T	COS	BIAIR	GC	TL	BI	K	BI:TL	BI:K	TL:K	TEMP	BP
55	41.0209	113.9530	-245.5	327	QLCS	0	0	0	0	30	0.6	1103	21	15	108	0.714	0.139	0.194	20.4	23.16
56	41.0209	113.9525	-245.4	322	QLCS	0	0	0	0	28	0.6	1137	21	14	105	0.667	0.133	0.200	20.3	23.15
57	41.0209	113.9520	-245.0	319	QLCS	0	0	0	0	32	0.6	1142	27	24	91	0.889	0.264	0.297	20.2	23.16
58	41.0209	113.9515	-244.4	313	QLCS	0	0	0	0	18	0.6	1206	29	27	112	0.931	0.241	0.259	20.3	23.16

1 BRIGHAM CITY
MAPLINE 1

RCN	TL RANK	GEO UNIT	BI RANK	A K U T	K RANK	LONG	BI/TL RANK	LAT	BI/K RANK	RMAG	TL/K RANK	COS	BIAIR	GC
1	5-1	WTR	1	0 0 1 0	26-1	112.2674	0.200	41.0255	0.028	20.8	0.139-1	20	12.1	336
2	4-1	WTR	0	0 0 1 0	34+0	112.2670	0.000	41.0255	0.000	20.7	0.091-1	26	12.1	478
3	1	WTR	15+0	0 1 0 1	0	112.2665	15.000	41.0255	1.500	87.4	0.100	28	12.1	454
4	1-1	WTR	6-1	0 0 0 0	14-1	112.2661	3.323+3	41.0255	0.260+0	120.6	0.078-1	22	12.1	428
5	1	WTR	5-1	0 0 0 1	14-1	112.2657	4.500	41.0255	0.226+0	170.7	0.050	29	12.1	476
6	1	WTR	3-1	0 0 0 1	15-1	112.2652	3.050	41.0255	0.152+0	4.5	0.050	38	12.1	465
7	1	WTR	1	0 0 1 1	16-1	112.2648	0.968	41.0255	0.070	6.7	0.072	30	12.1	440
8	2	WTR	0	0 0 1 1	17-1	112.2644	0.344	41.0255	0.025	11.4	0.073	29	12.1	427
9	2-1	WTR	0	0 0 1 0	18-1	112.2639	0.152	41.0256	0.016	20.2	0.103-1	36	12.1	494
10	3-1	WTR	0	0 0 1 0	19-1	112.2635	0.074	41.0256	0.009	30.8	0.116-1	22	12.1	410
11	3-1	WTR	0	0 0 1 0	21-1	112.2631	-0.089	41.0256	-0.010	43.8	0.112-1	30	12.1	461
12	3-1	WTR	0	0 0 1 0	24-1	112.2626	-0.222	41.0256	-0.026	57.5	0.116-1	20	12.1	472
13	3-1	WTR	-1	0 0 1 0	25-1	112.2622	-0.468	41.0256	-0.051	89.3	0.109-1	24	12.1	460
14	4-1	WTR	-1	0 0 1 0	24-1	112.2617	-0.409	41.0256	-0.050	105.0	0.121-1	28	12.1	424
15	4-1	WTR	0	0 0 1 0	21-1	112.2613	-0.057	41.0256	-0.008	120.6	0.140-1	28	12.1	467
16	4-1	WTR	1	0 0 1 0	18-1	112.2609	0.278	41.0256	0.044	134.0	0.158-1	32	12.1	467
17	4-1	WTR	3-1	0 0 0 0	16-1	112.2604	0.849+0	41.0257	0.145+0	145.3	0.171-1	24	12.1	511
18	5-1	WTR	5-1	0 0 0 0	20-1	112.2600	1.088+0	41.0257	0.176+0	156.3	0.162-1	27	12.1	580
19	5-1	WTR	5-1	0 0 0 0	27-1	112.2596	1.011+0	41.0257	0.157+0	166.0	0.156-1	30	12.1	586
20	7-1	WTR	6-1	0 0 0 0	34+0	112.2591	0.930+0	41.0257	0.149+0	173.4	0.160-1	21	12.1	693
21	8-1	WTR	6-1	0 0 0 0	43+0	112.2587	0.721+0	41.0257	0.118+0	176.4	0.164-1	31	12.7	705
22	10-1	WTR	6-1	0 0 0 0	48+0	112.2583	0.650+0	41.0257	0.113+0	178.4	0.174-1	38	12.7	761
23	11+0	WTR	7-1	0 0 0 0	52+0	112.2578	0.656+0	41.0257	0.121+0	178.6	0.185-1	36	12.7	804
24	13+0	WTR	8-1	0 0 0 0	57+0	112.2574	0.604+0	41.0257	0.119+0	176.8	0.196-1	27	12.7	892
25	15+0	WTR	8-1	0 0 0 0	63+0	112.2570	0.531+0	41.0258	0.109+0	174.2	0.206+0	32	12.7	913
26	16+0	WTR	8+0	0 0 0 0	71+0	112.2565	0.519+0	41.0258	0.106+0	172.2	0.205+0	27	12.7	1000
27	18+0	WTR	8-1	0 0 0 0	77+0	112.2561	0.444+0	41.0258	0.094+0	168.4	0.211+0	34	12.7	1077

1 BRIGHAM CITY
MAPLINE 1

RCN	TL RANK	GEO UNIT	BI RANK	A K U T	K RANK	LONG	BI/TL RANK	LAT	BI/K RANK	RMAG	TL/K RANK	COS	BIAIR	GC

APPENDIX III

PRODUCTION SUMMARY

APPENDIX III

PRODUCTION SUMMARY - Survey Time Period

ML/TL	Date	Surveyed Line Miles	Average Alt/Day	Average Speed/Day
ML(1-4)W	4/28/78	206	419	78
TL(3,5)S	4/30/78	69	378	75
TL(6-7),ML7E, ML(10-18)W	7/4/78	568	472	73
ML(1-6,8-10, 13-14)E	7/7/78	569	474	74
ML(11-12,15-18)E,ML9W, TL9	7/9/78	430	459	73
ML(5-8)W,10C TL1S,1N,2,3N, 4,5N,8	7/10/78	487	427	75
	TOTAL	2,329		

TABLE AIII-1 Test Line Results

UNIT	APRIL 28	APRIL 30	JULY 4*	JULY 7	JULY 9	JULY 10
PRE COS	24.48	24.98	28.35	34.00	27.15	27.49
POS COS	25.85	27.50	30.23	31.01	28.45	29.56
Tl	22.41	21.12	42.71	41.71	43.09	42.24
Tl	27.47	19.73	42.13	40.30	44.42	41.92
Bi	22.99	20.48	19.32	18.57	18.87	18.90
Bi	21.65	15.48	18.79	17.59	19.11	18.65
K	71.16	68.07	106.38	105.92	108.65	108.44
K	82.01	63.15	105.29	104.44	111.19	105.41
GC	1204.18	1224.10	1681.03	1755.05	1731.32	1729.32
GC	1311.11	1206.10	1696.42	1731.35	1762.51	1716.89
BIAIR	3.51	4.77	3.76	9.51	8.55	8.16
BIAIR	6.54	10.98	6.01	8.56	7.47	5.93
ALT	396.52	392.54	436.45	473.41	402.00	405.46
ALT	384.41	380.63	594.18	446.70	397.85	376.10

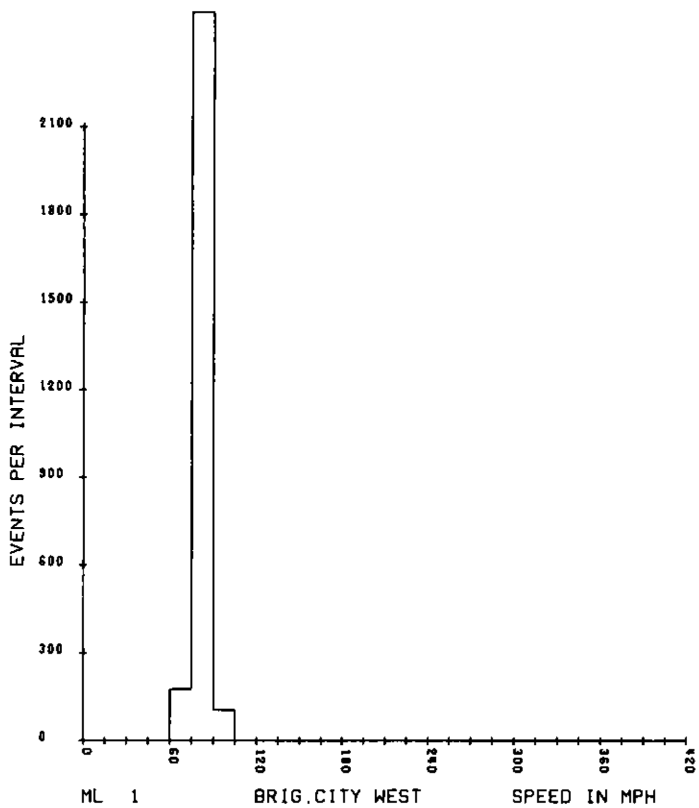
* NEW BASE LINE

TABLE AIII-2 Average Lama I Speed and Altitude Determined from Data of Appendix II

Map Line	Average Speed	Average Altitude
1E	67	
2	78	426
3	73	461
4	82	451
5	76	542
6	68	491
7	76	549
8	68	543
9	74	443
10	76	511
11	79	537
12	77	528
13	67	458
14	73	409
15	75	448
16	79	422
17	69	480
18	71	454
10C	40	409
1W	80	403
2	82	410
3	75	436
4	75	427
5	65	413
6	70	436
7	72	479
8W	78	424
9	60	398
10	77	429
11	79	428
12	80	453
13	82	454
14	65	452
15	69	476
16	73	558
17	71	518
18	62	436
TL1N	72	375
2	78	444
3N	71	483
4	80	423
5N	76	415
6	74	403
7	71	510
8	72	460
9	78	402
15	69	367
35	73	380
5S	76	376

TABLE AIII-3 Diurnal Corrections to Map Line Data

ML/TL	CORRECTION/GAMMAS	ML/TL	CORRECTION/GAMMAS
1E	12	7	-8
2	13	8	-6
3	14	9	7
4	14	10	1
5	15	11	-7
6	18	12	-7
7	-3	13	-5
8	17	14	-3
9	11	15	0
10	7	16	7
11	-1	17	16
12	17	18	17
13	-3	TL1N	4
14	-1	2	9
15	17	3N	17
16	15	4	18
17	14	5N	16
18	10	6	-4
10C	-9	7	14
1W	17	8	13
2	10	9	5
3	0	1S	-8
4W	-2	3	-3
5	-1	5	-5
6	-4		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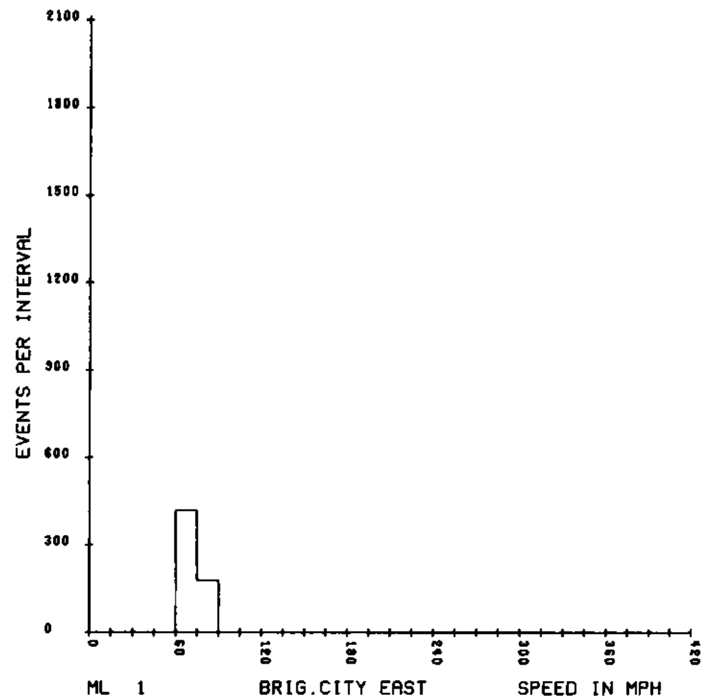
BRIG.CITY WEST
SPEED IN MPH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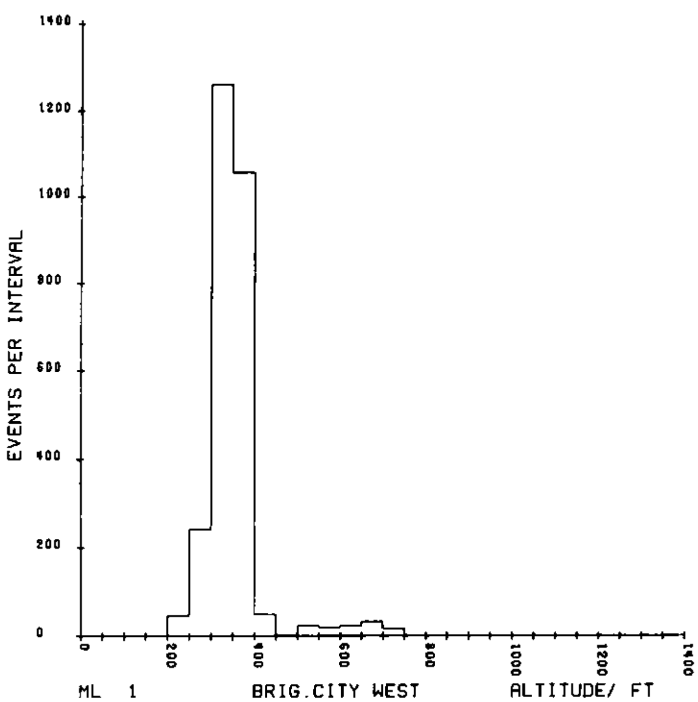
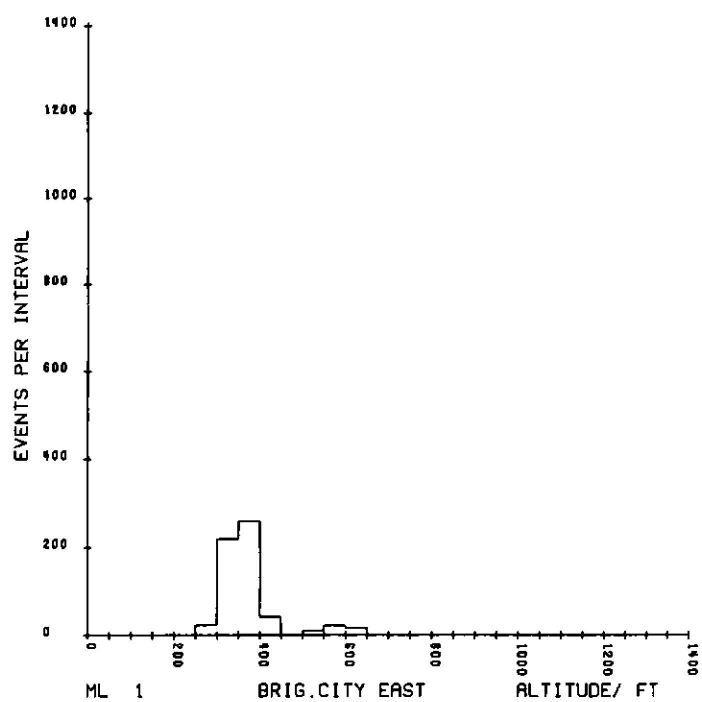
ML 1
BRIG.CITY EAST
SPEED IN MPH


EVENTS PER INTERVAL
ML 1
BRIG.CITY WEST
ALTITUDE/ FT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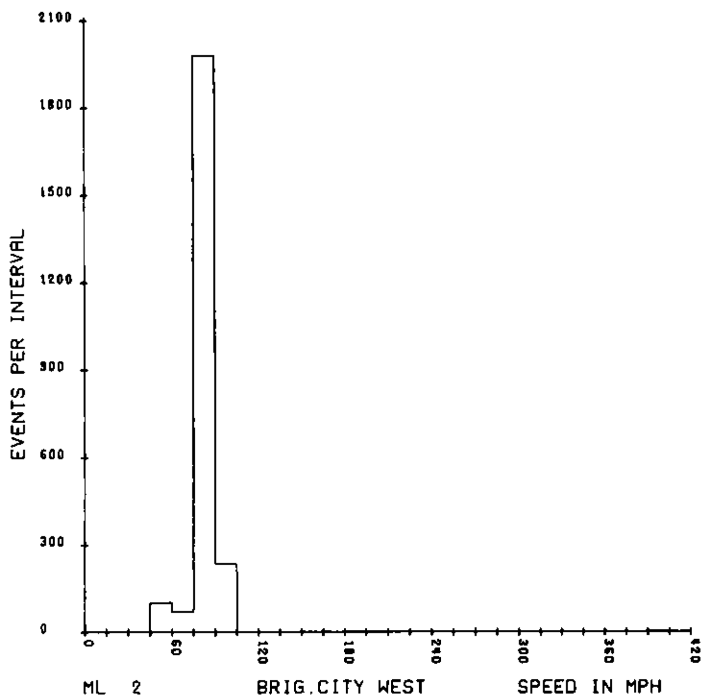
BRIG.CITY EAST
ALTITUDE/ FT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1200
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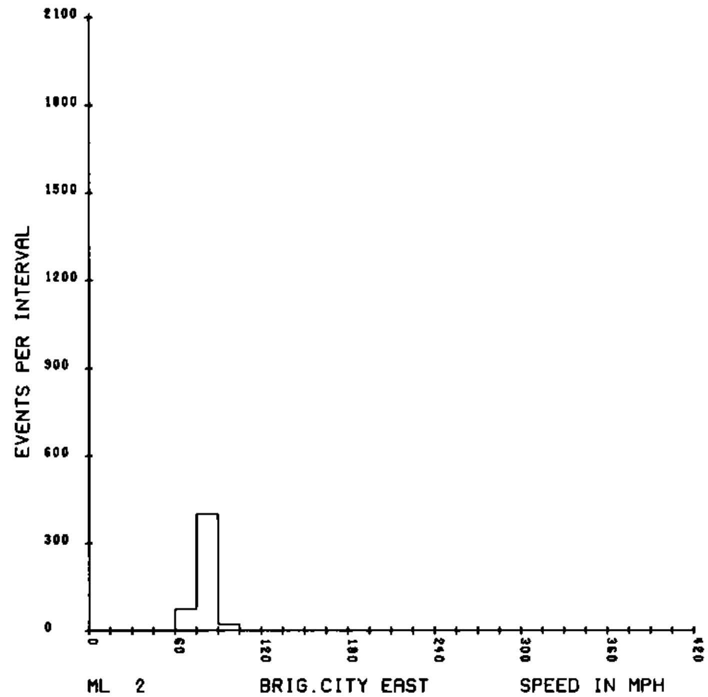
0
60
120
180
240
300
360
420
ML 2
BRIG.CITY WEST
SPEED IN MPH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1800
1500
1200
900
600
300
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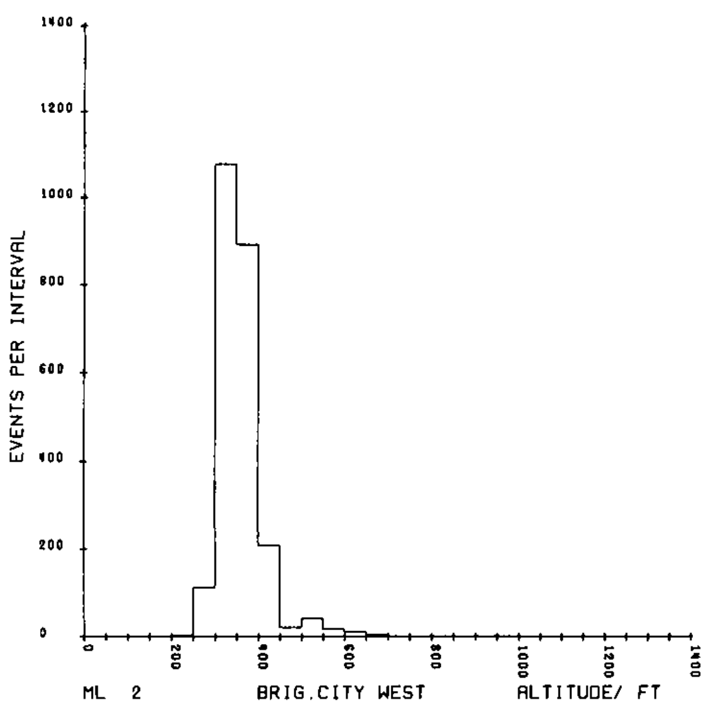
0
60
120
180
240
300
360
420
ML 2
BRIG.CITY EAST
SPEED IN MPH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800
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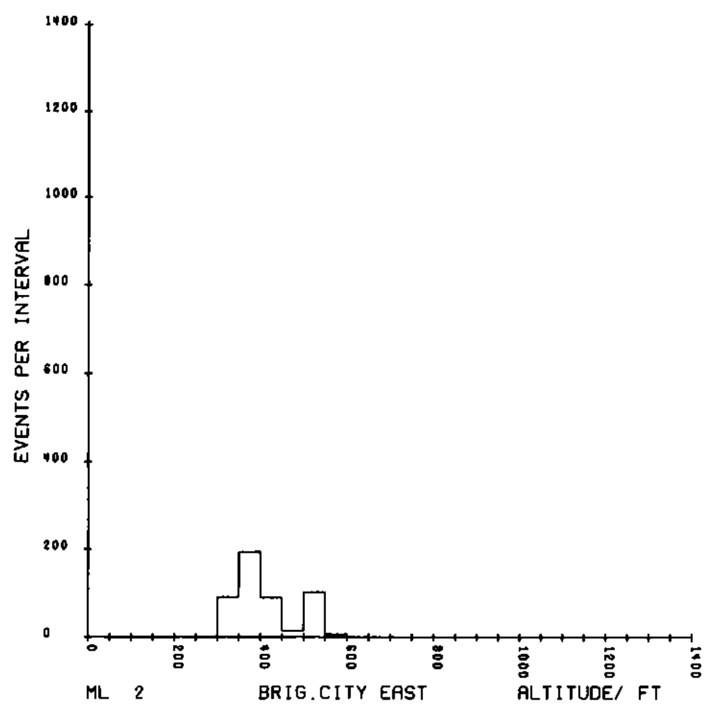
1400
ML 2
BRIG.CITY WEST
ALTITUDE/ FT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200
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200
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800
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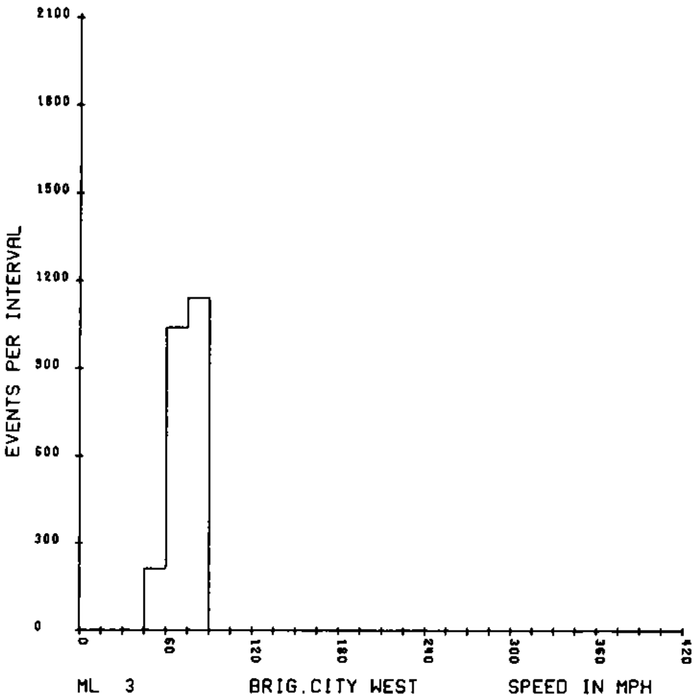
ML 2
BRIG.CITY EAST
ALTITUDE/ FT


EVENTS PER INTERVAL
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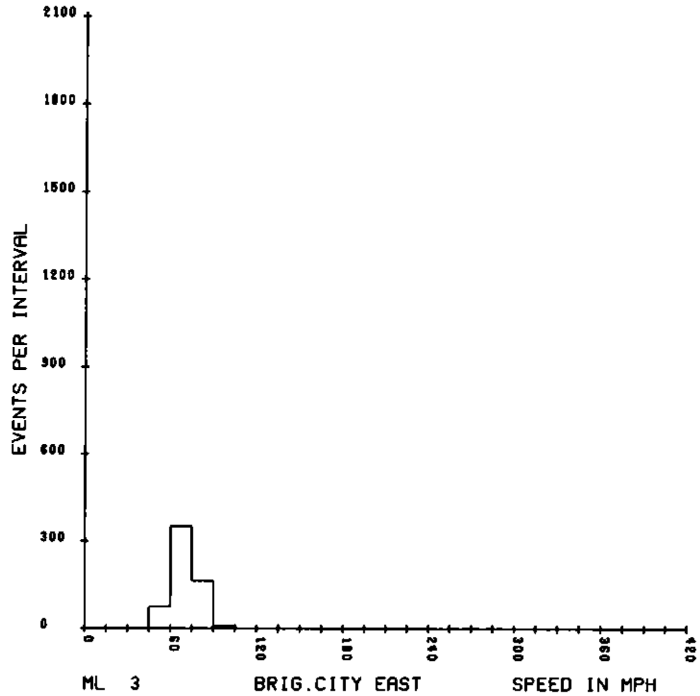
600
900
1200
1500
1800
2100
0
60
120
180
240
300
360
420
ML 3
BRIG.CITY WEST
SPEED IN MPH


EVENTS PER INTERVAL
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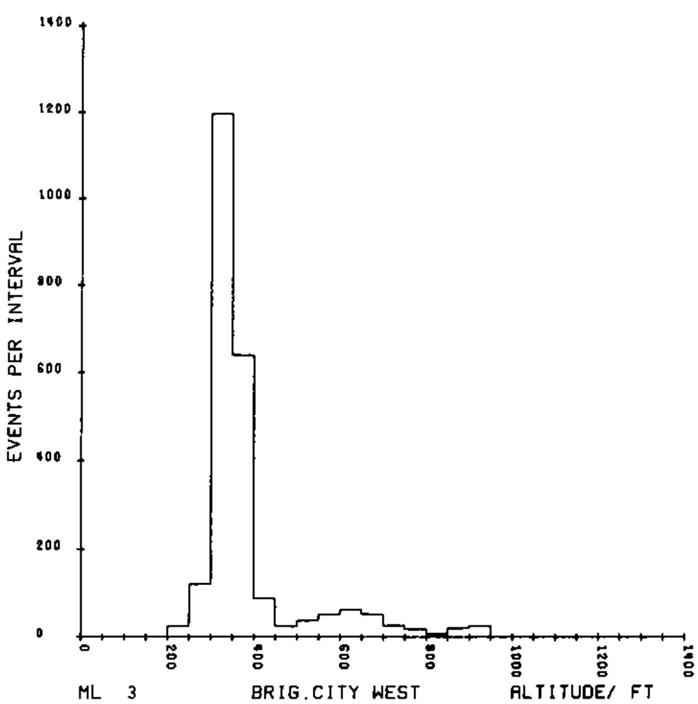
300
600
900
1200
1500
1800
2100
0
60
120
180
240
300
360
420
ML 3
BRIG.CITY EAST
SPEED IN MPH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600
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1400
0
200
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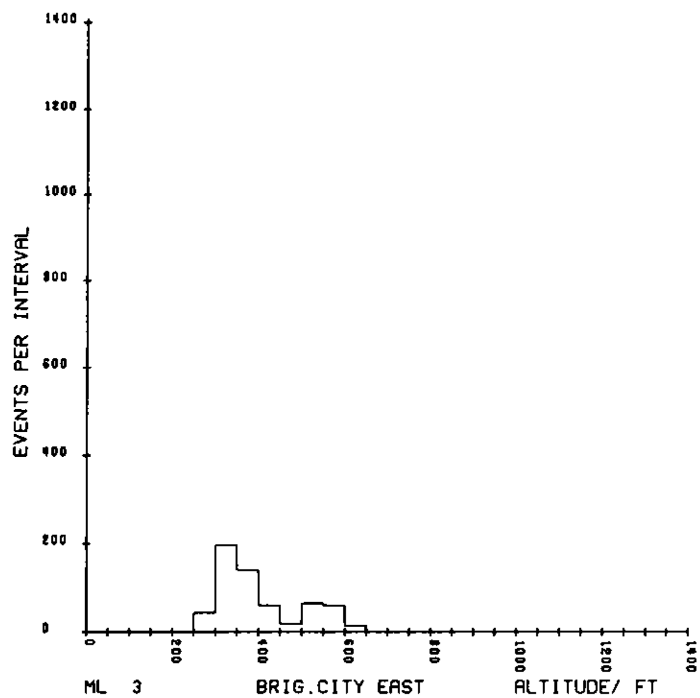
600
800
1000
1200
1400
ML 3
BRIG.CITY WEST
ALTITUDE/ FT


EVENTS PER INTERVAL
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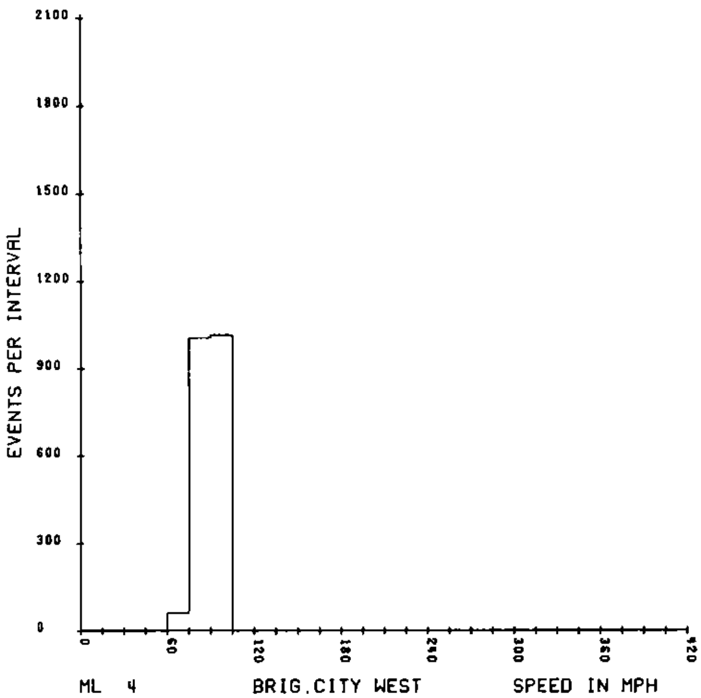
400
600
800
1000
1200
1400
0
200
400
600
800
1000
1200
1400
ML 3
BRIG.CITY EAST
ALTITUDE/ FT



2100
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EVENTS PER INTERVAL
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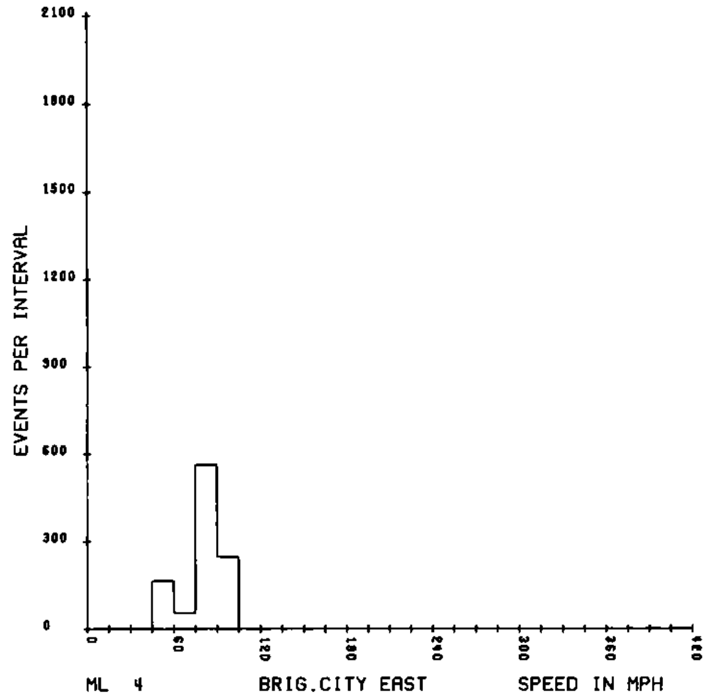
420
ML 4
BRIG.CITY WEST
SPEED IN MPH



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EVENTS PER INTERVAL
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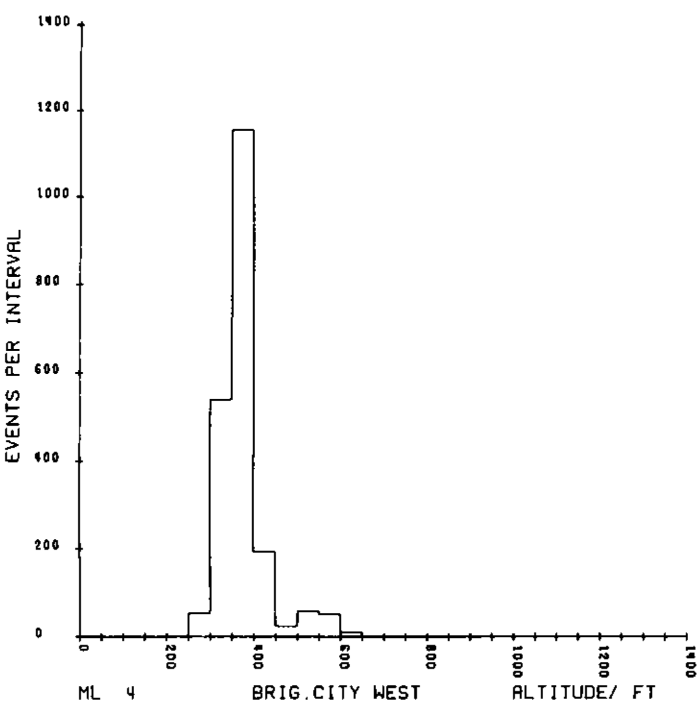
ML 4
BRIG.CITY EAST
SPEED IN MPH



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EVENTS PER INTERVAL
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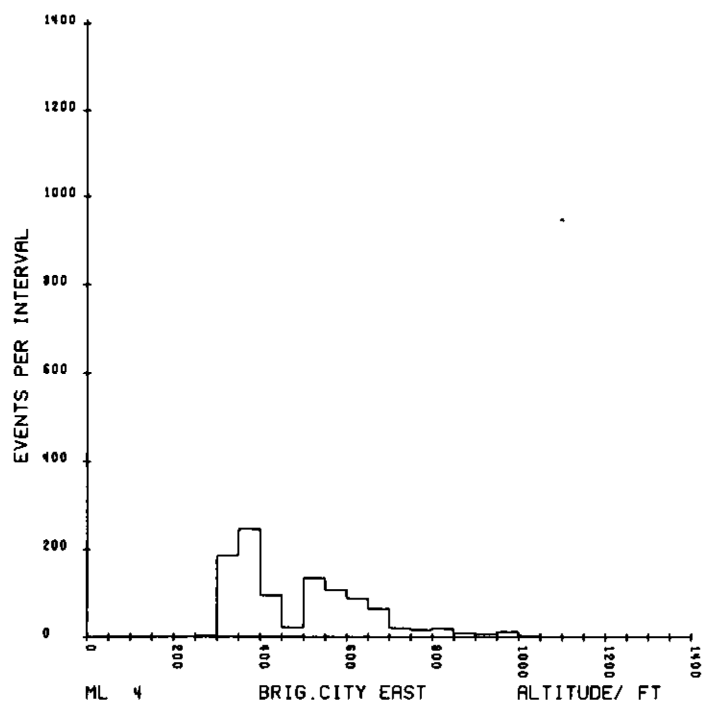
1400
ML 4
BRIG.CITY WEST
ALTITUDE/ FT



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EVENTS PER INTERVAL
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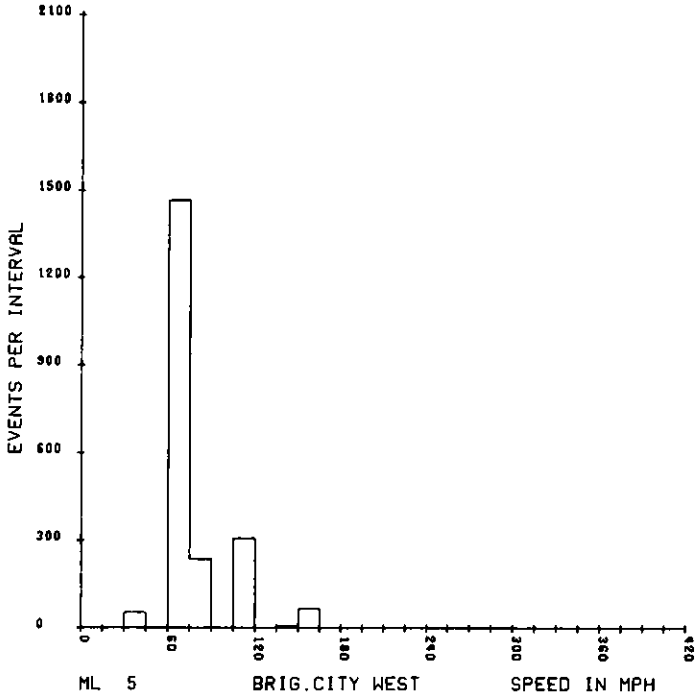
BRIG.CITY EAST
ALTITUDE/ FT


EVENTS PER INTERVAL
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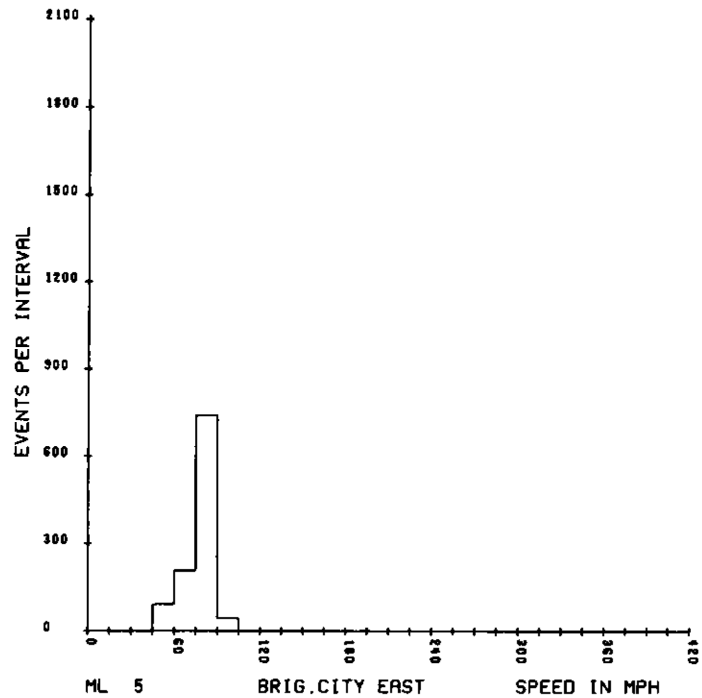
SPEED IN MPH


EVENTS PER INTERVAL
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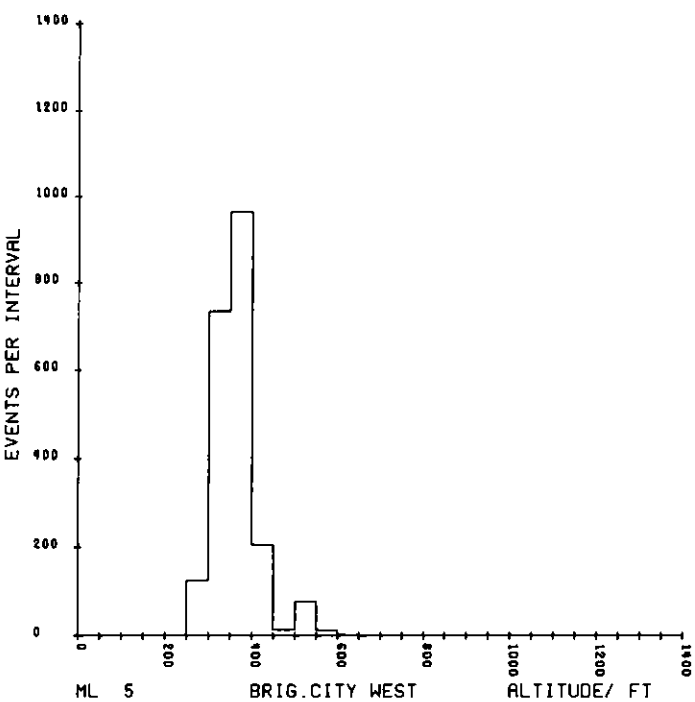
BRIG.CITY EAST
SPEED IN MPH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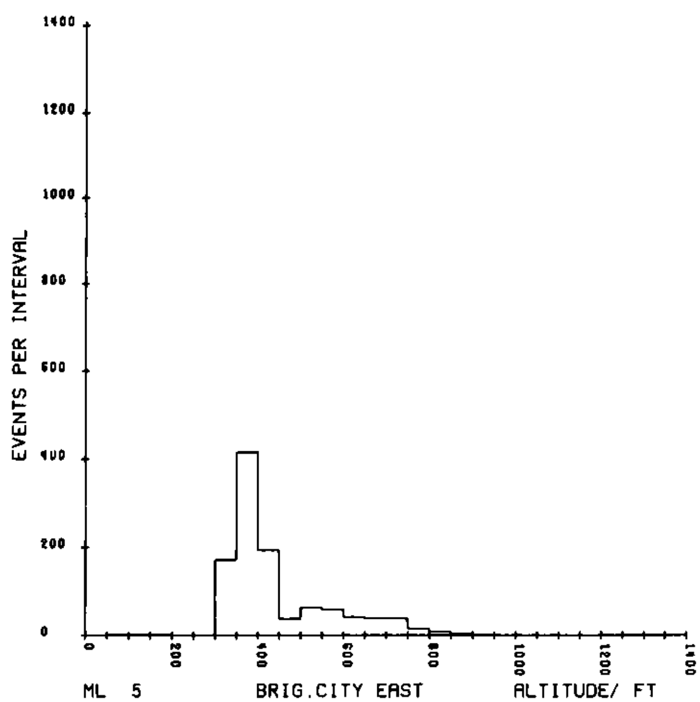
1400
ML 5
BRIG.CITY WEST
ALTITUDE/ FT


EVENTS PER INTERVAL
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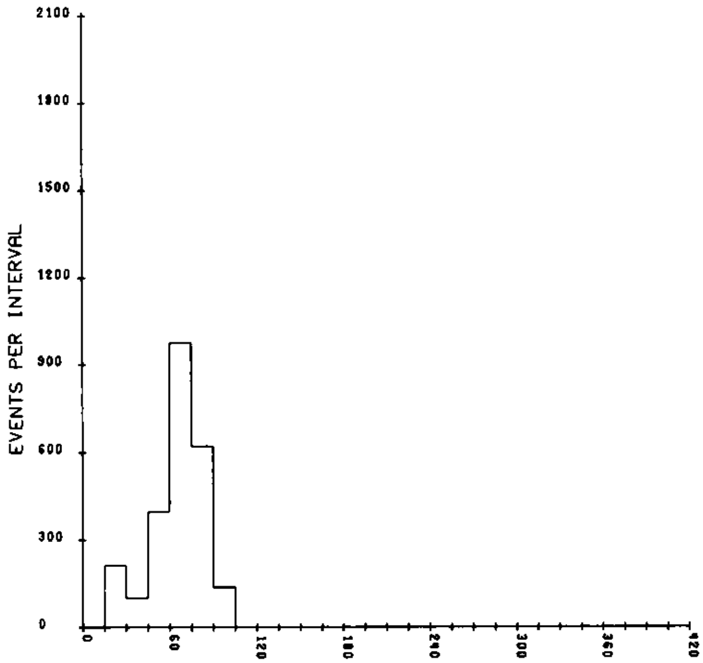
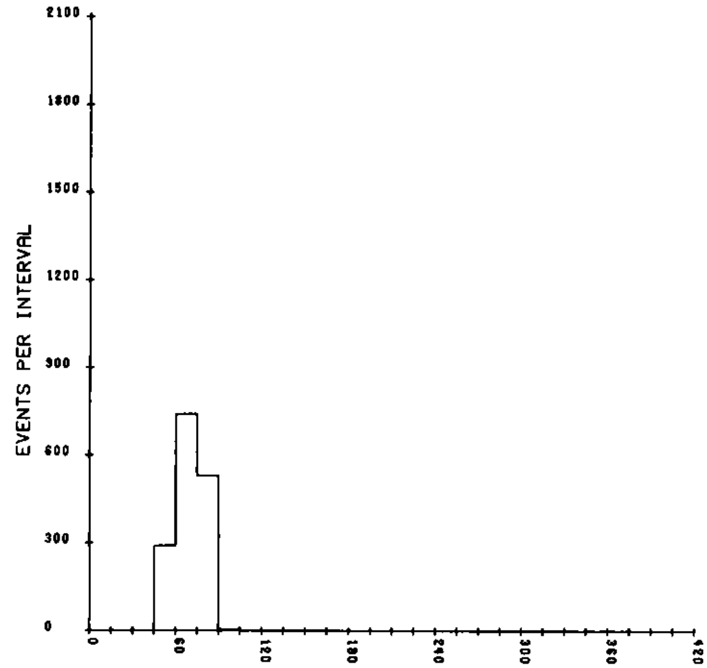
ML 5
BRIG.CITY EAST
ALTITUDE/ FT



ML 6 BRIG.CITY WEST SPEED IN MPH



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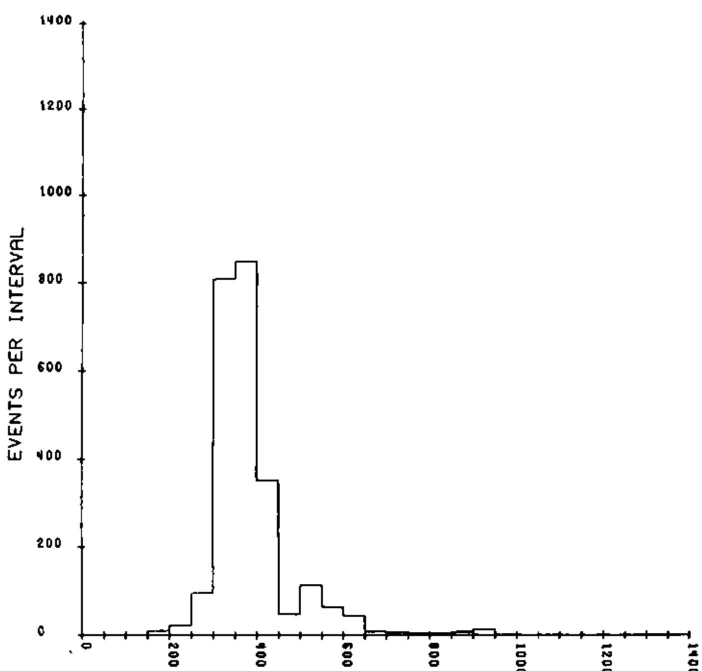
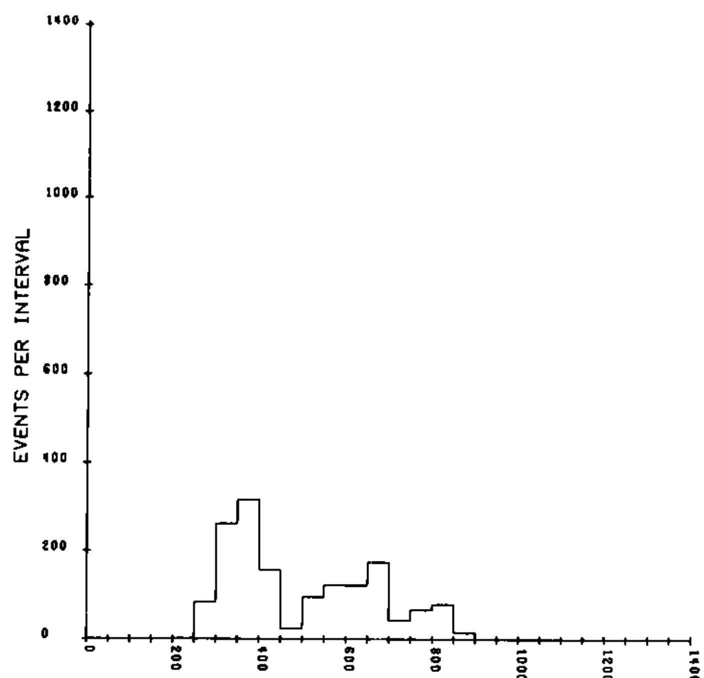
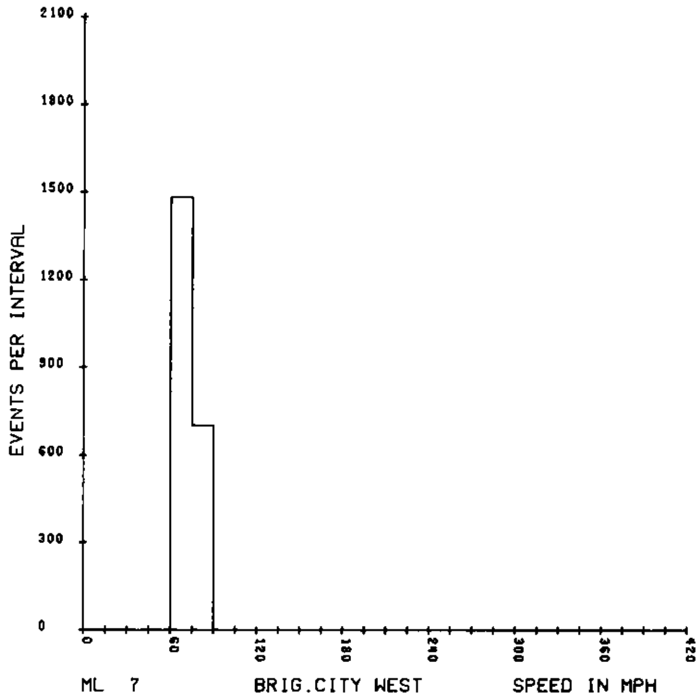
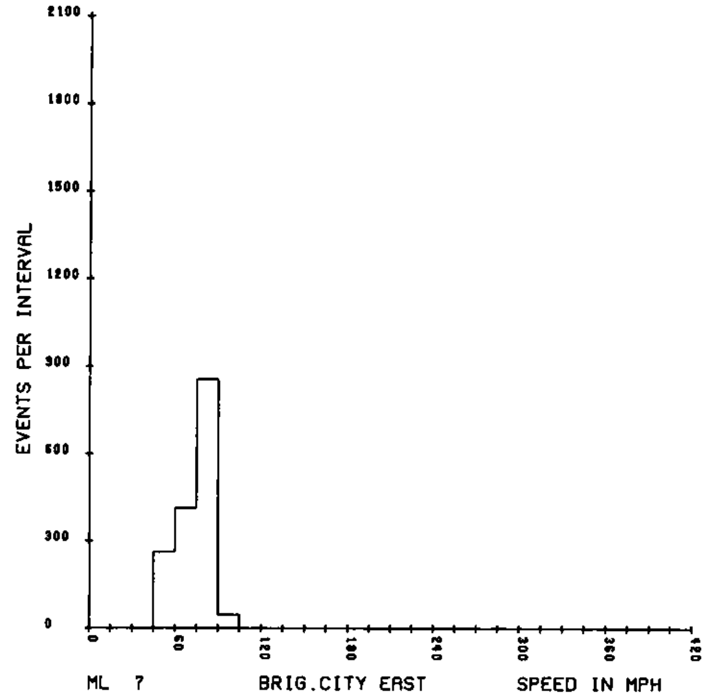


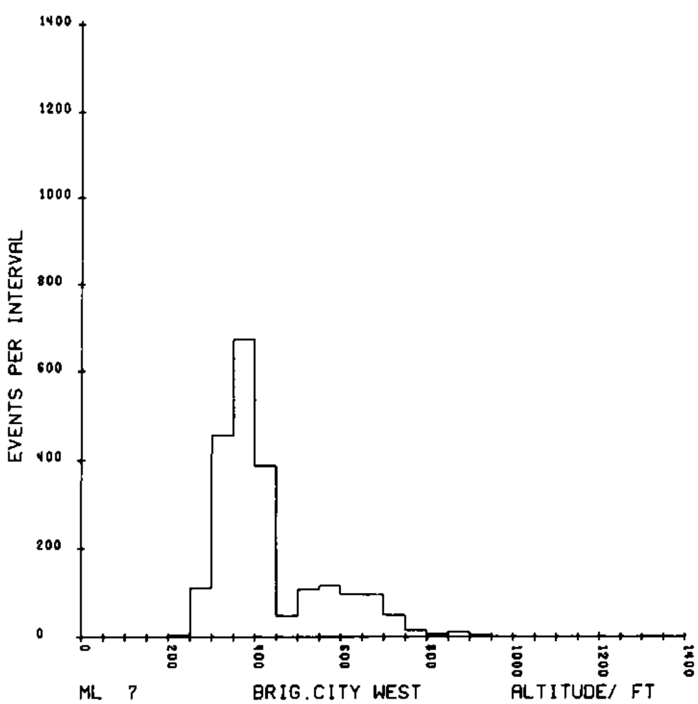
ML 6 BRIG.CITY WEST ALTITUDE/ FT

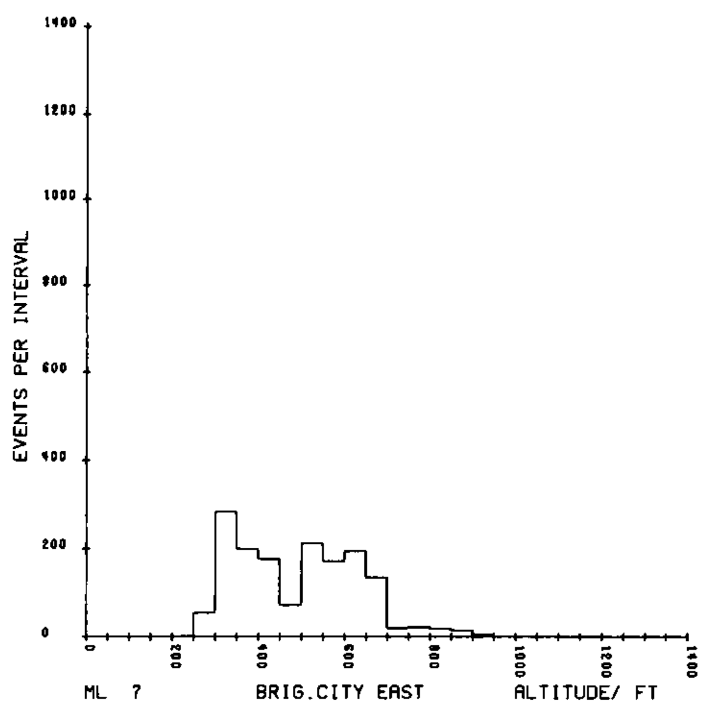


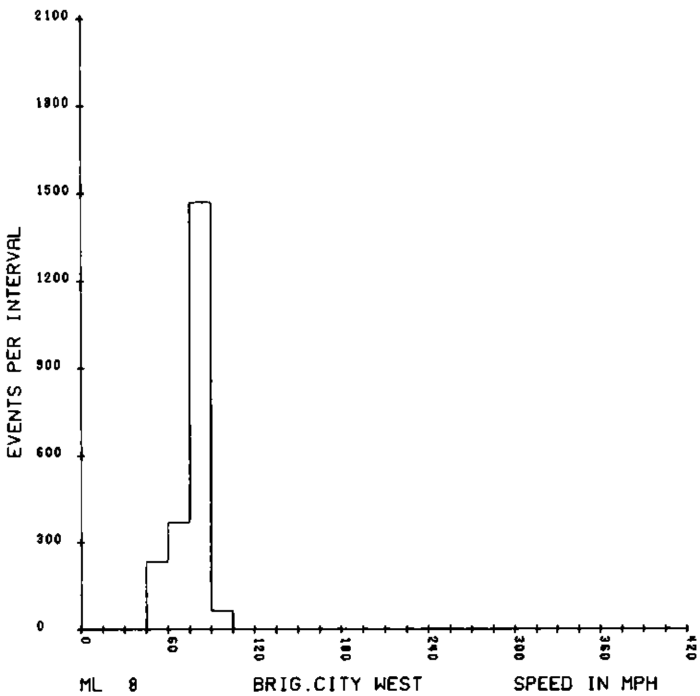
ML 6 BRIG.CITY EAST ALTITUDE/ FT


EVENTS PER INTERVAL
ML 7
BRIG.CITY WEST
SPEED IN MPH


EVENTS PER INTERVAL
ML 7
BRIG.CITY EAST
SPEED IN MPH


EVENTS PER INTERVAL
ML 7
BRIG.CITY WEST
ALTITUDE/ FT


EVENTS PER INTERVAL
ML 7
BRIG.CITY EAST
ALTITUDE/ FT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EVENTS PER INTERVAL
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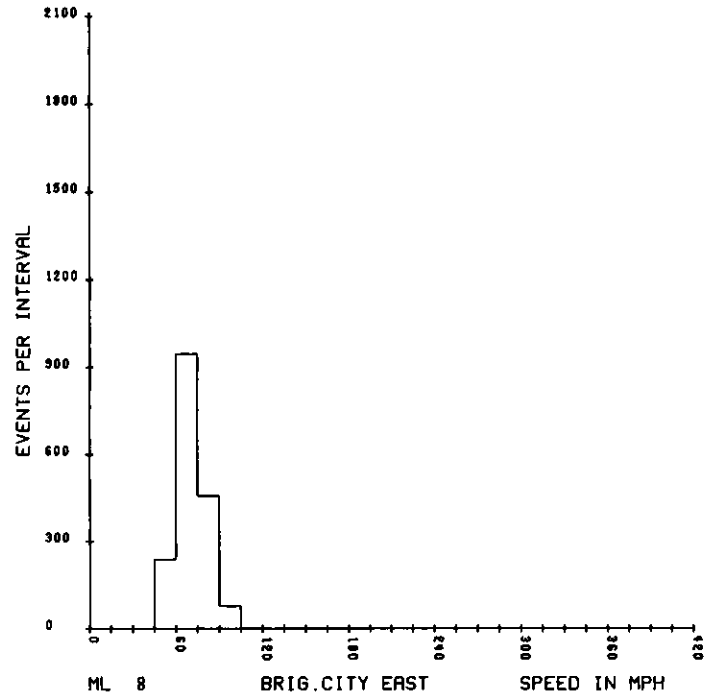
BRIG.CITY WEST
SPEED IN MPH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EVENTS PER INTERVAL
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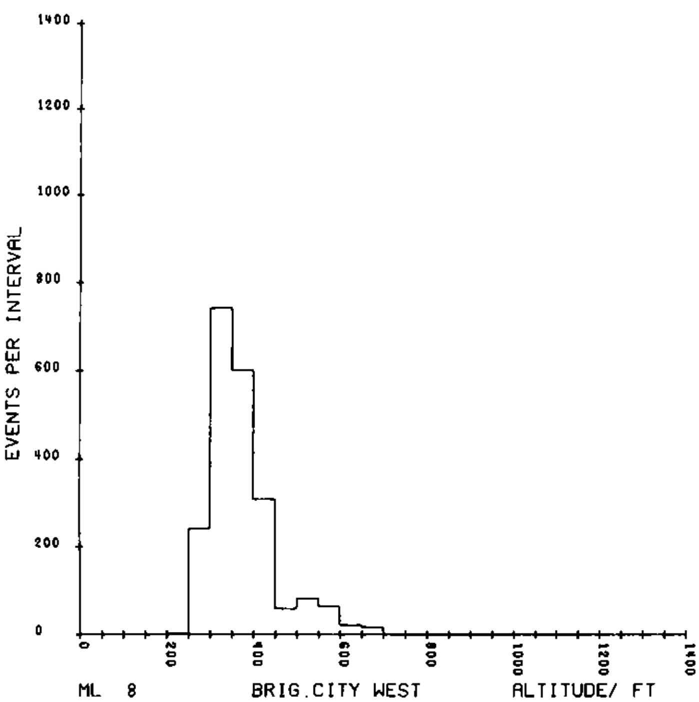
ML 8
BRIG.CITY EAST
SPEED IN MPH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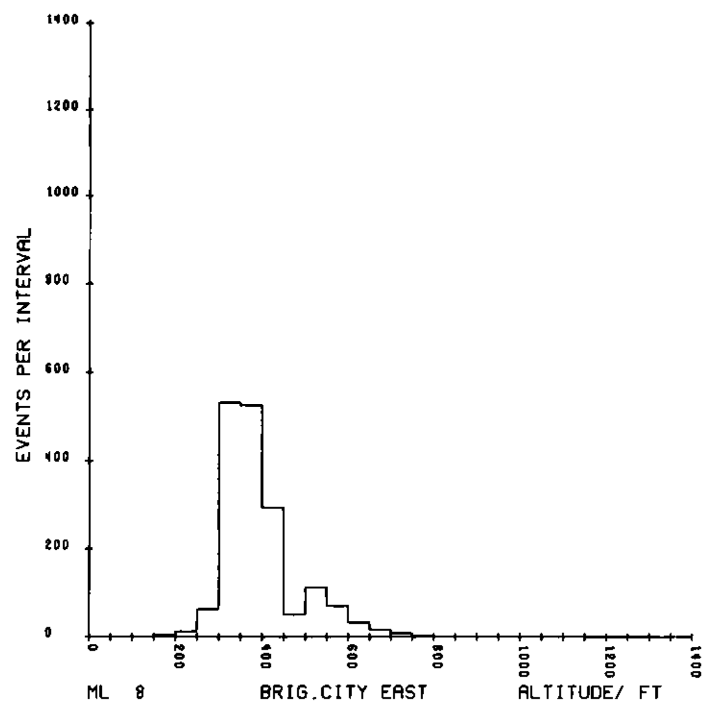
ML 8
BRIG.CITY WEST
ALTITUDE/ FT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EVENTS PER INTERVAL
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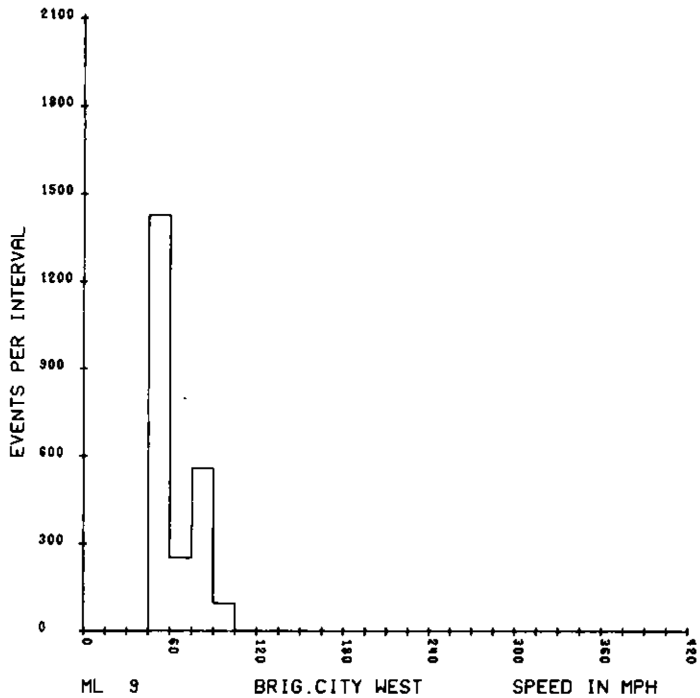
ML 8
BRIG.CITY EAST
ALTITUDE/ FT


EVENTS PER INTERVAL
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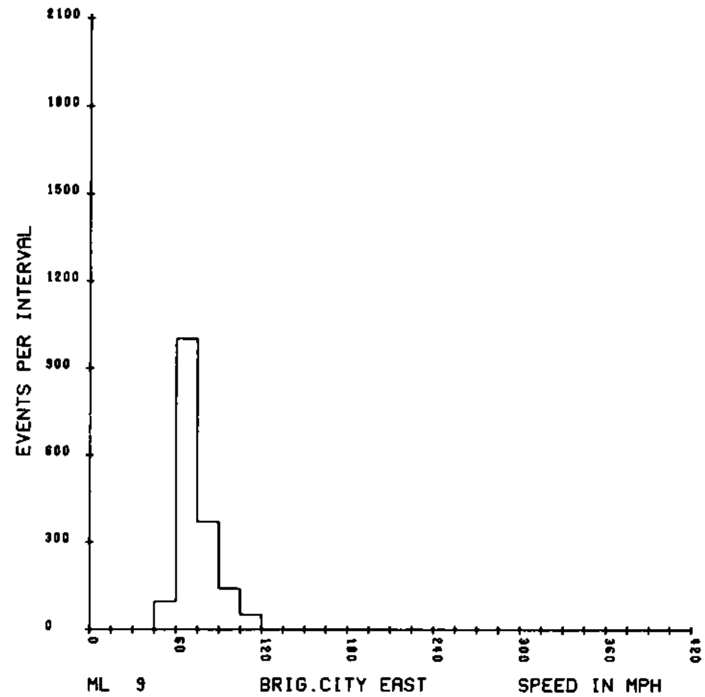
ML 9
BRIG.CITY WEST
SPEED IN MPH


EVENTS PER INTERVAL
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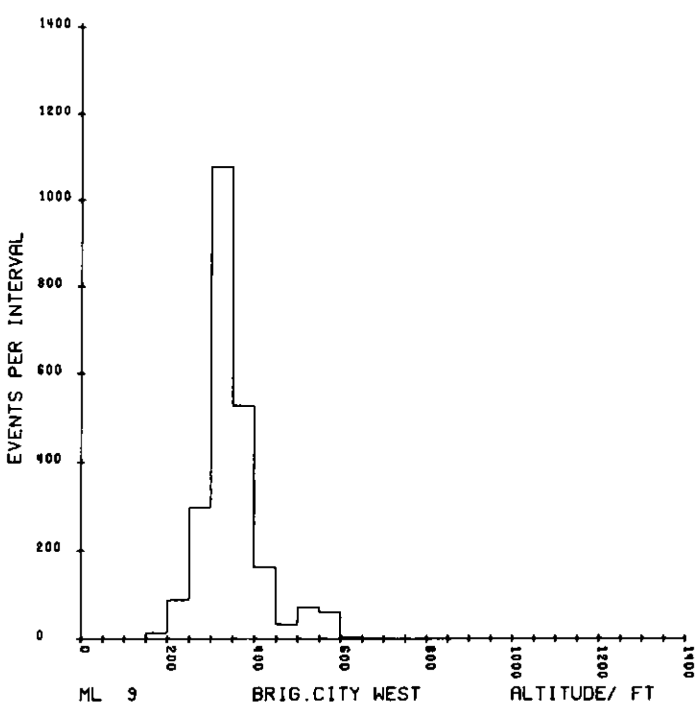
ML 9
BRIG.CITY EAST
SPEED IN MPH


EVENTS PER INTERVAL
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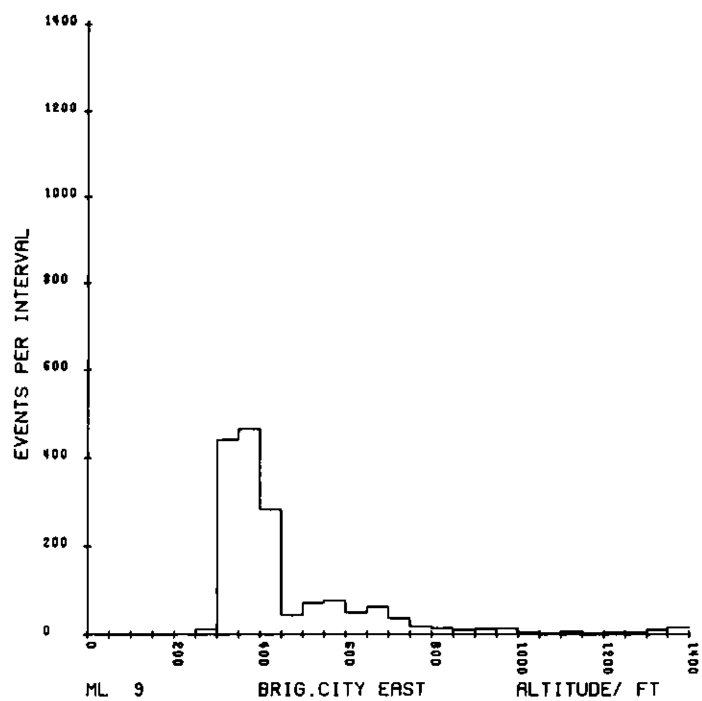
ML 9
BRIG.CITY WEST
ALTITUDE/ FT


EVENTS PER INTERVAL
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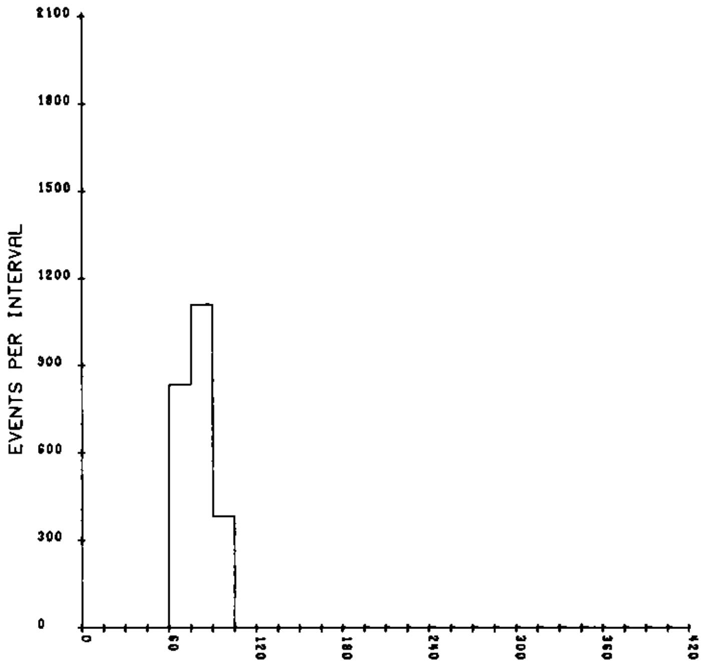
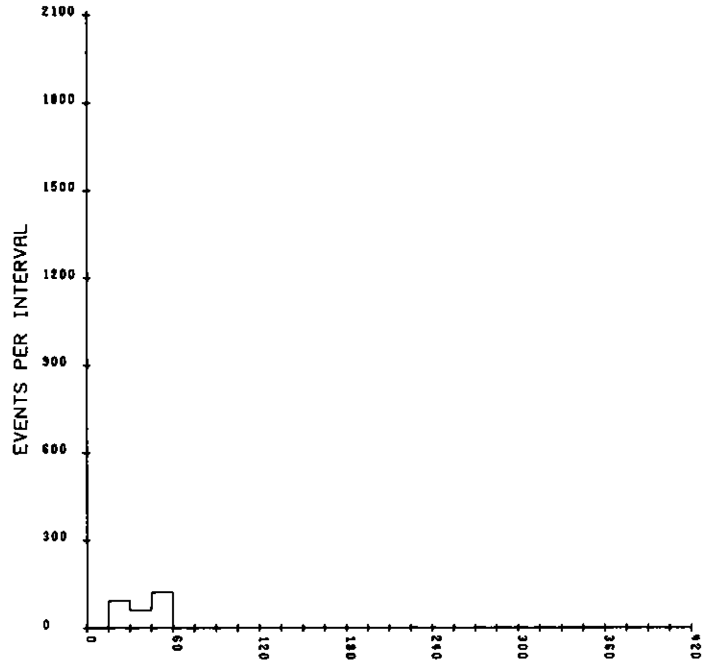
BRIG.CITY EAST
ALTITUDE/ FT



ML 10 BRIG.CITY WEST SPEED IN MPH



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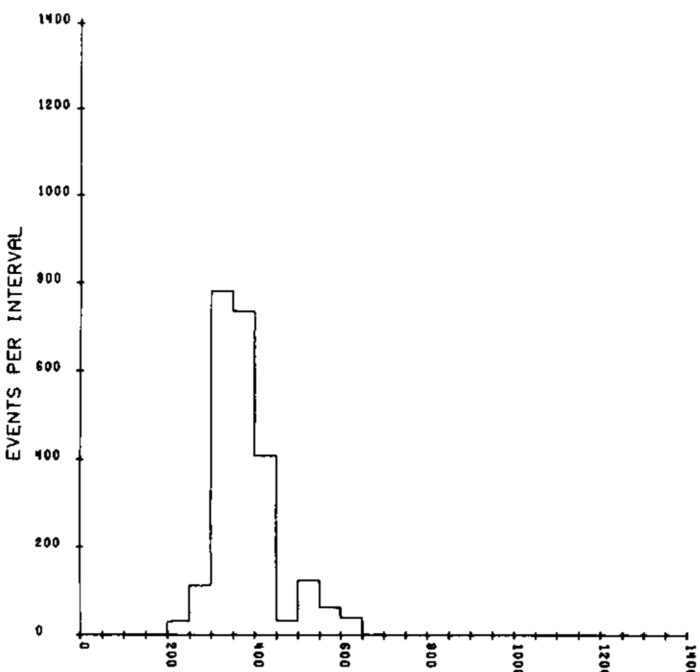
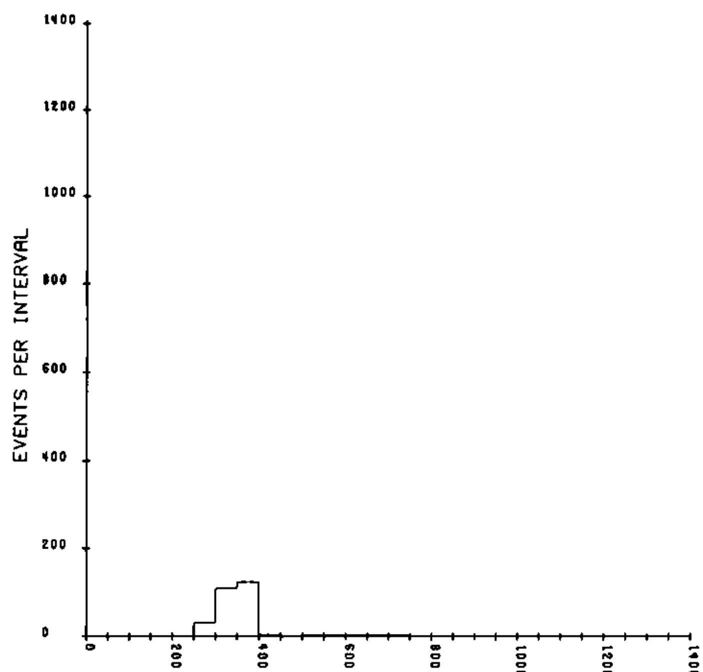


ML 10 BRIG.CITY WEST ALTITUDE/ FT



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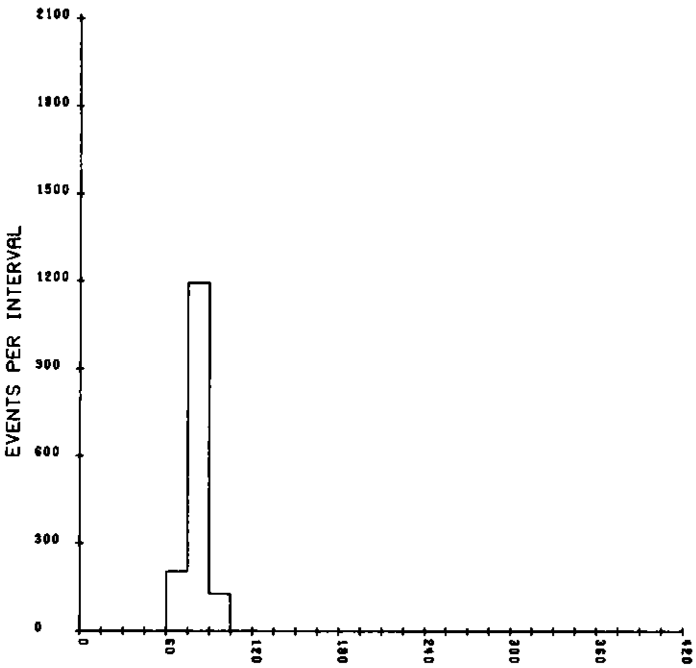

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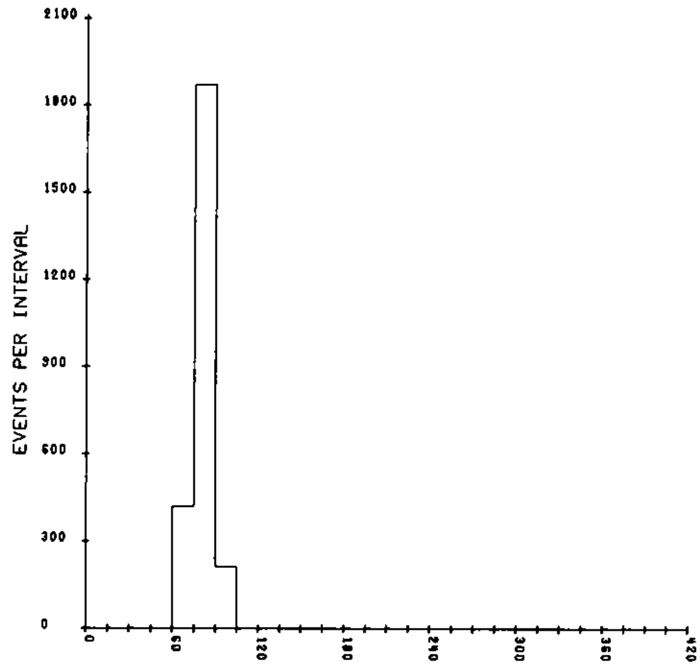
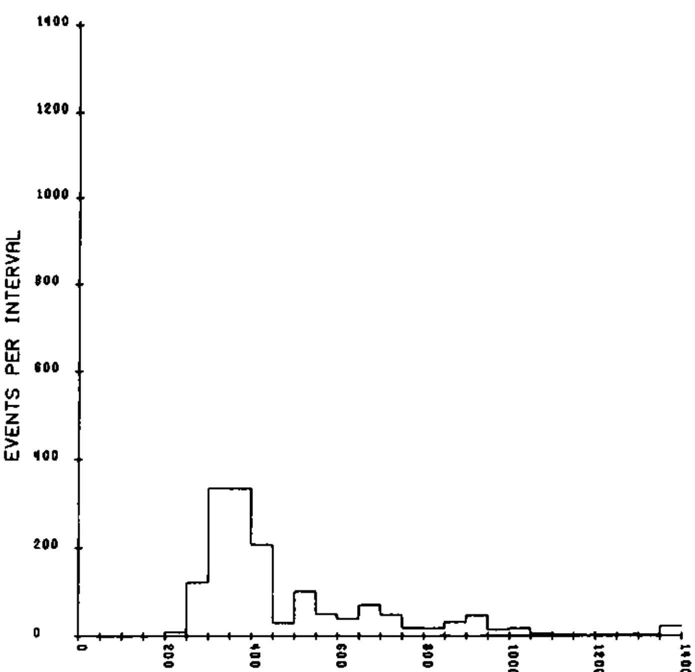
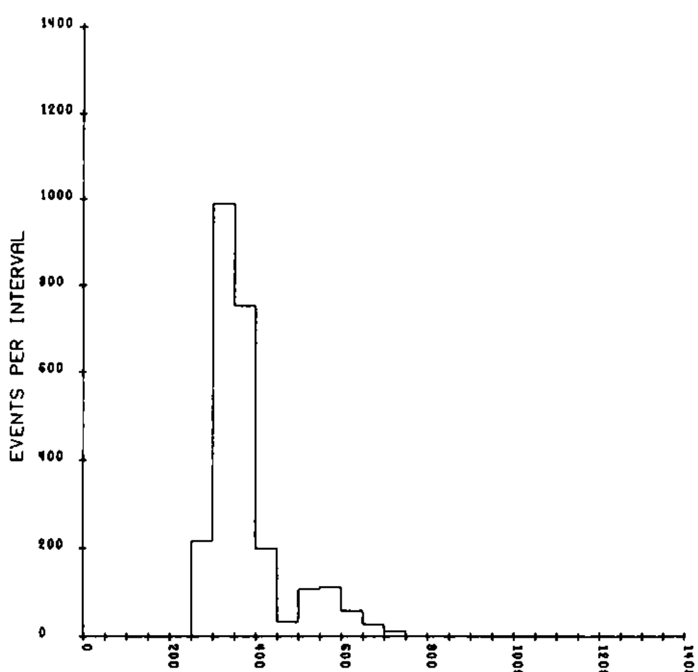


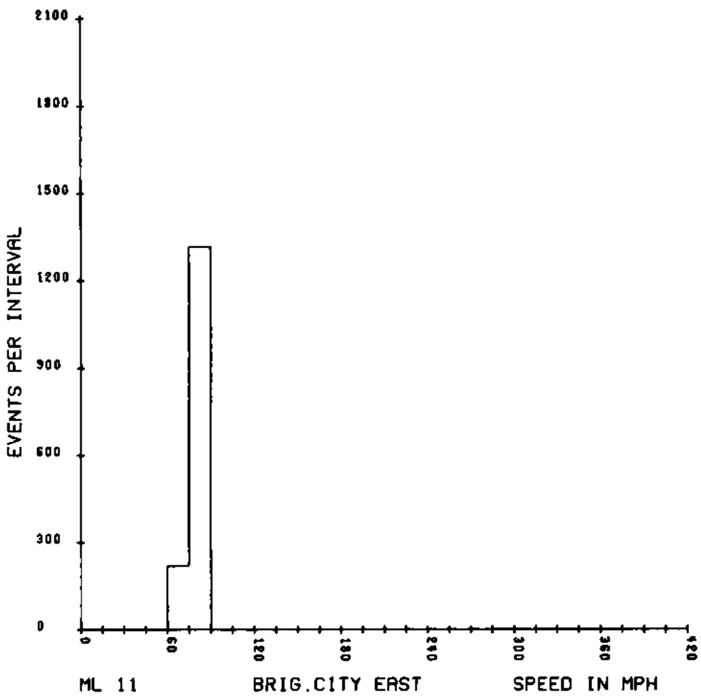
ML 11 BRIG.CITY WEST SPEED IN MPH



ML 10 BRIG.CITY EAST ALTITUDE/ FT



ML 11 BRIG.CITY WEST ALTITUDE/ FT


EVENTS PER INTERVAL
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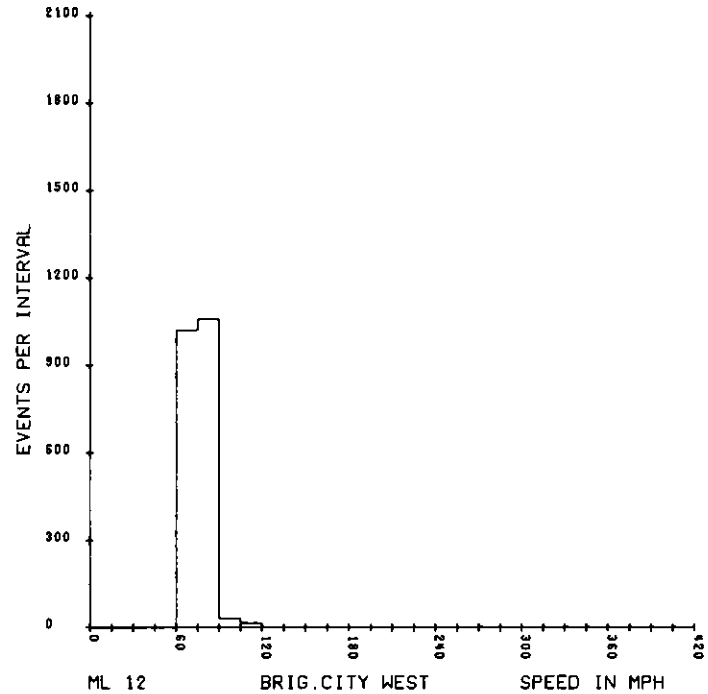
ML 11
BRIG.CITY EAST
SPEED IN MPH


EVENTS PER INTERVAL
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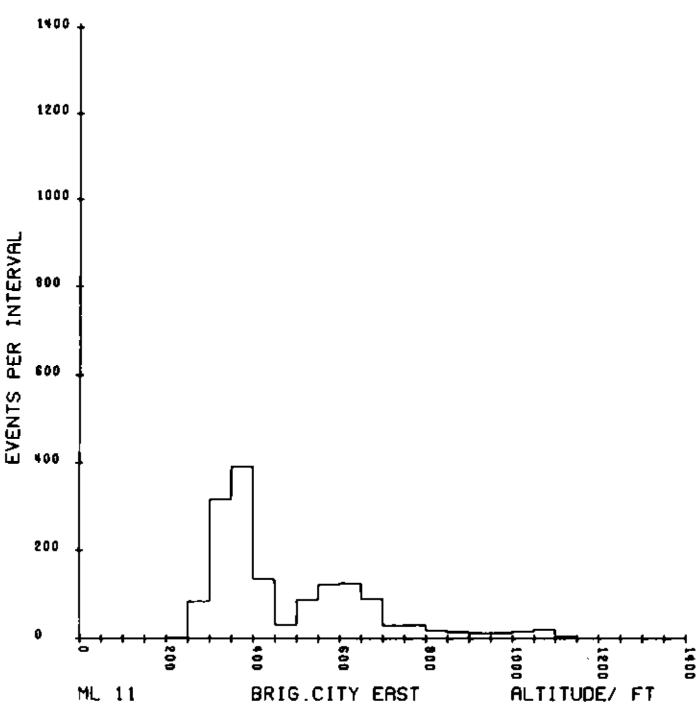
SPEED IN MPH


EVENTS PER INTERVAL
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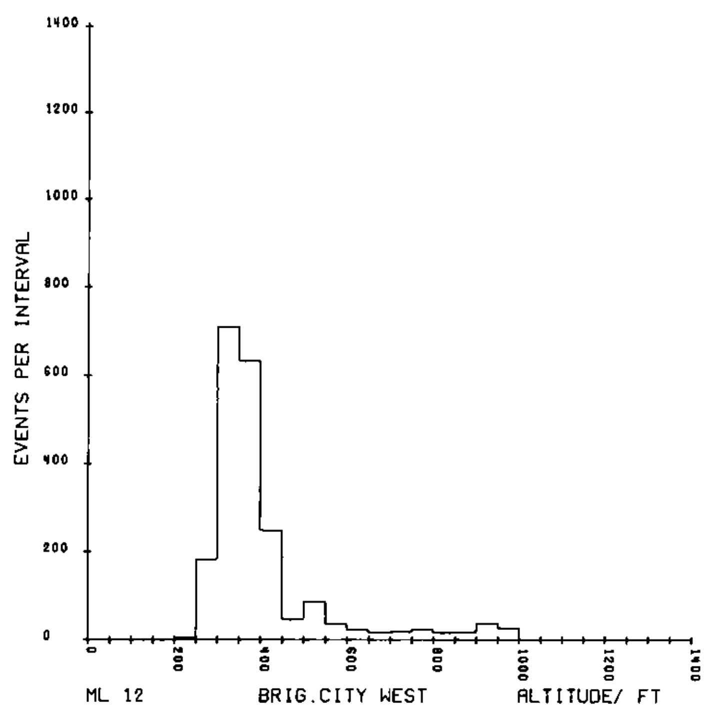
BRIG.CITY EAST
ALTITUDE/ FT


EVENTS PER INTERVAL
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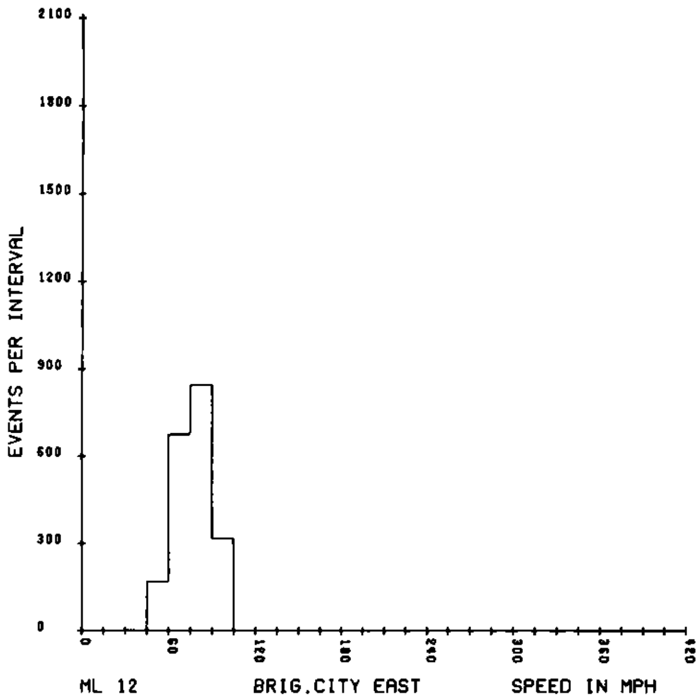
BRIG.CITY WEST
ALTITUDE/ FT



EVENTS PER INTERVAL
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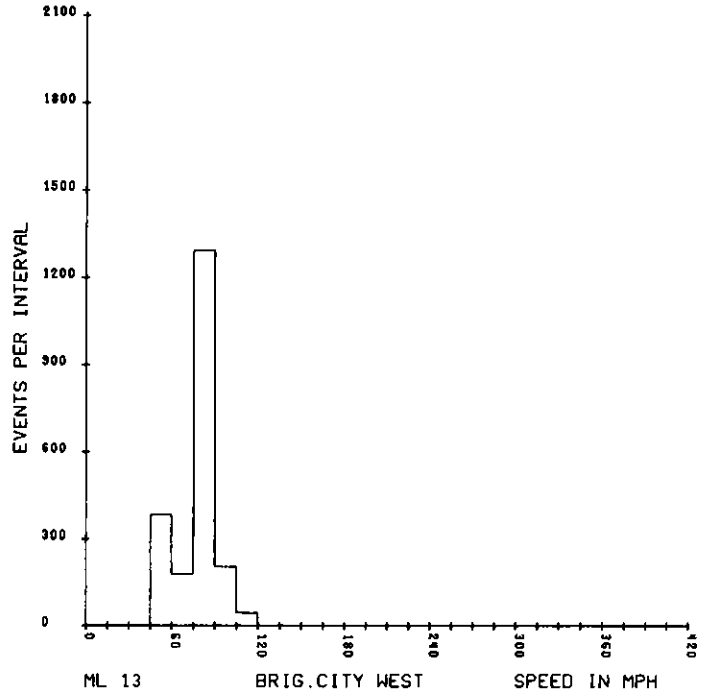
BRIG.CITY EAST
SPEED IN MPH



EVENTS PER INTERVAL
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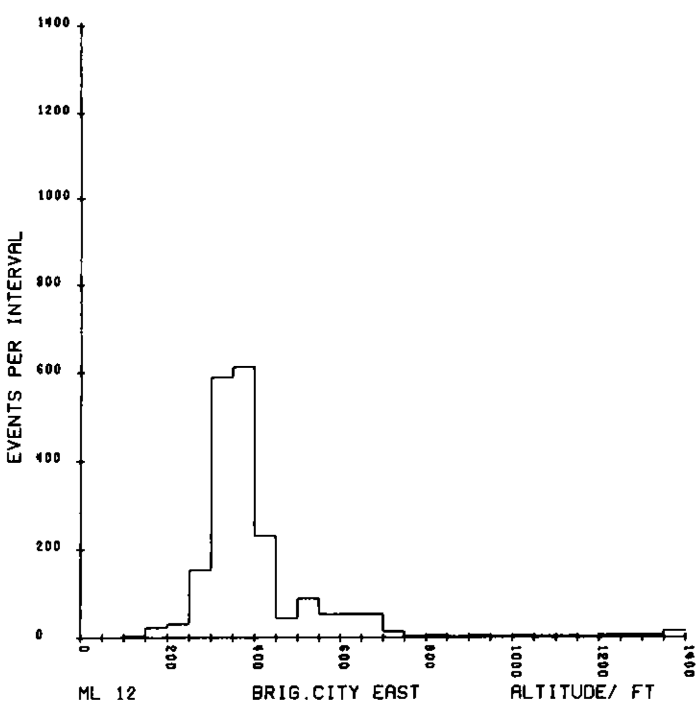
ML 13
BRIG.CITY WEST
SPEED IN MPH



EVENTS PER INTERVAL
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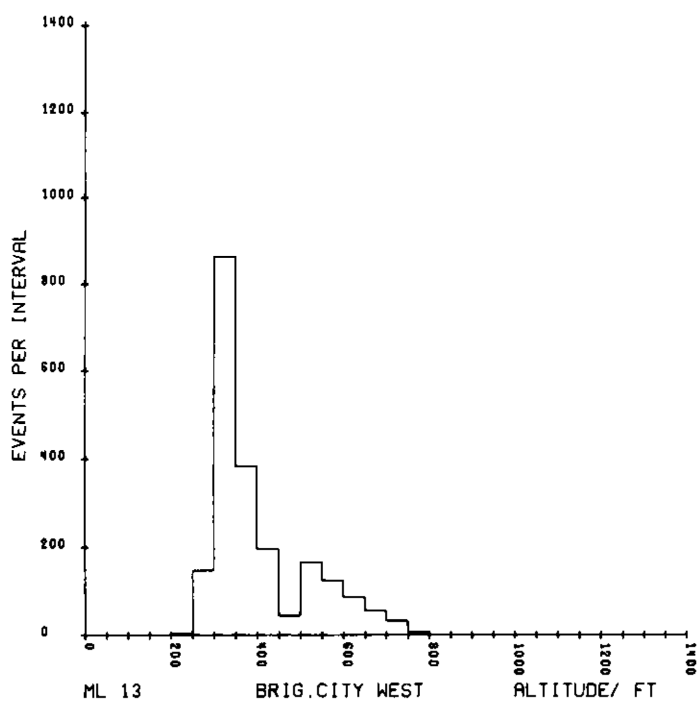
ML 12
BRIG.CITY EAST
ALTITUDE/ FT



EVENTS PER INTERVAL
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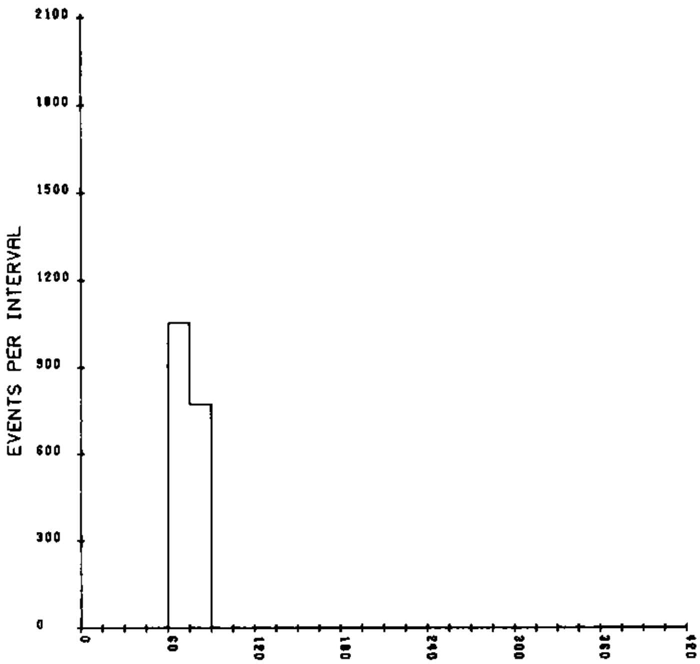
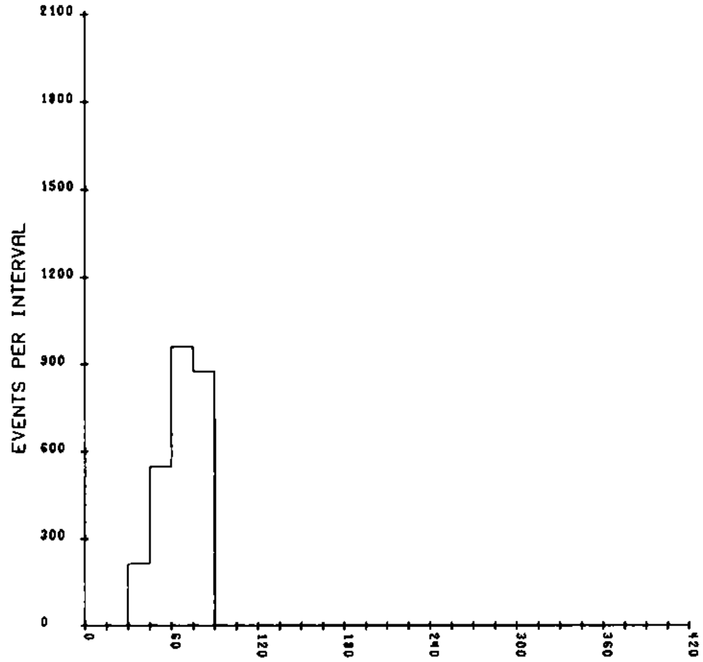
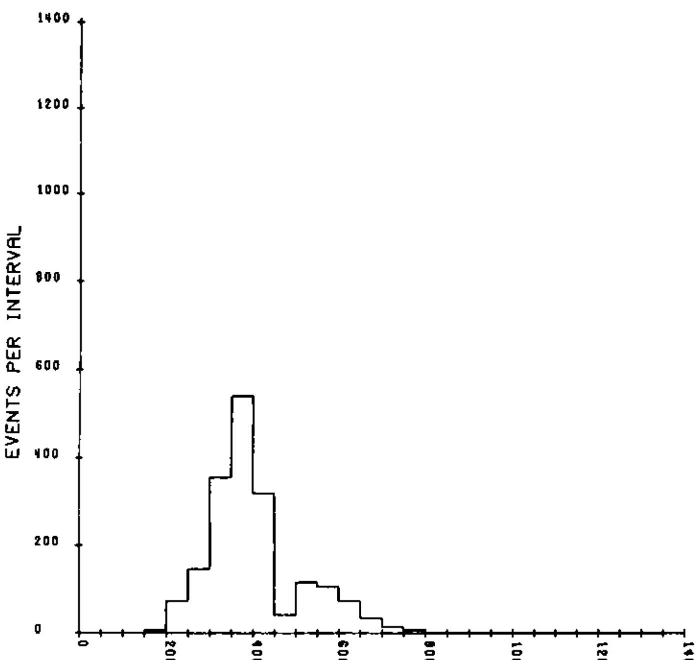
ML 13
BRIG.CITY WEST
ALTITUDE/ FT



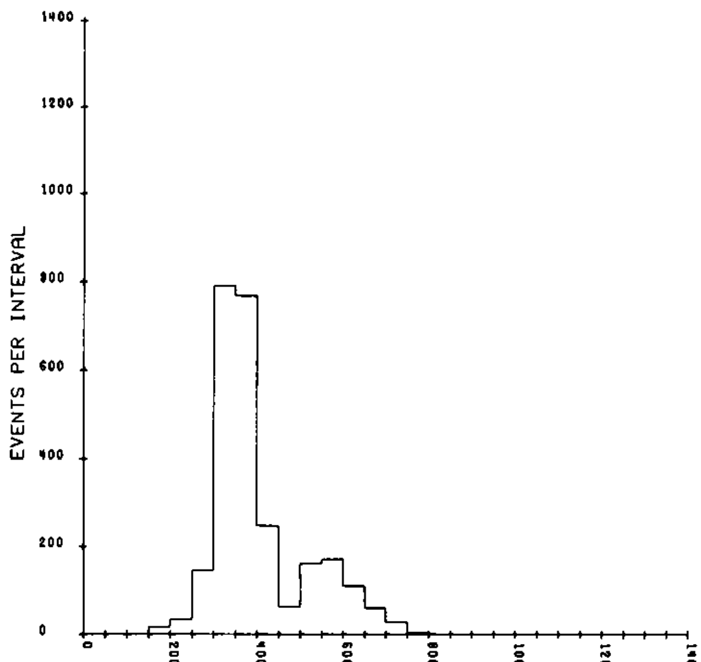
ML 13 BRIG.CITY EAST SPEED IN MPH



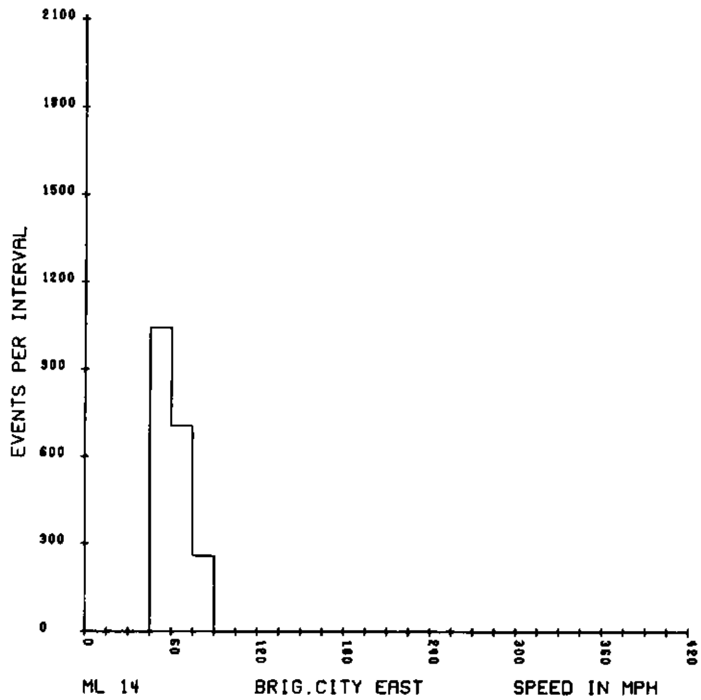
ML 14 BRIG.CITY WEST SPEED IN MPH



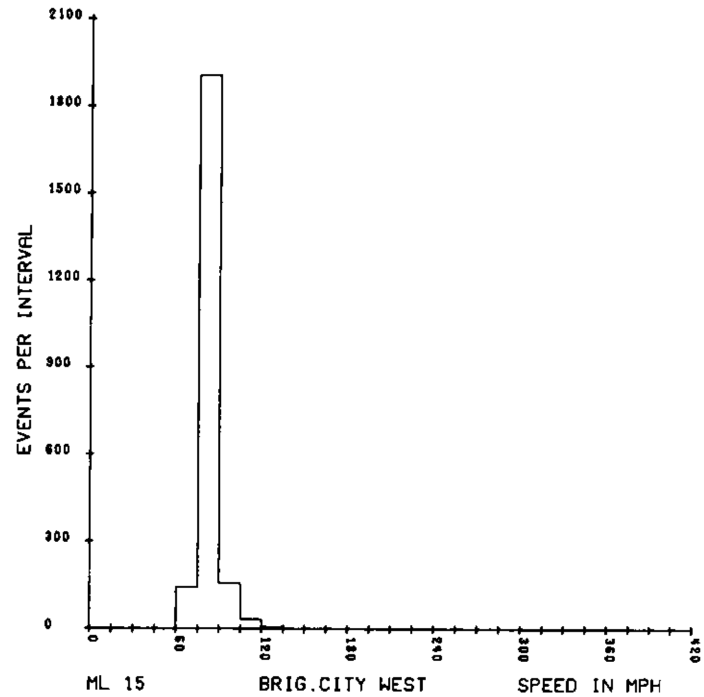
ML 13 BRIG.CITY EAST ALTITUDE/ FT



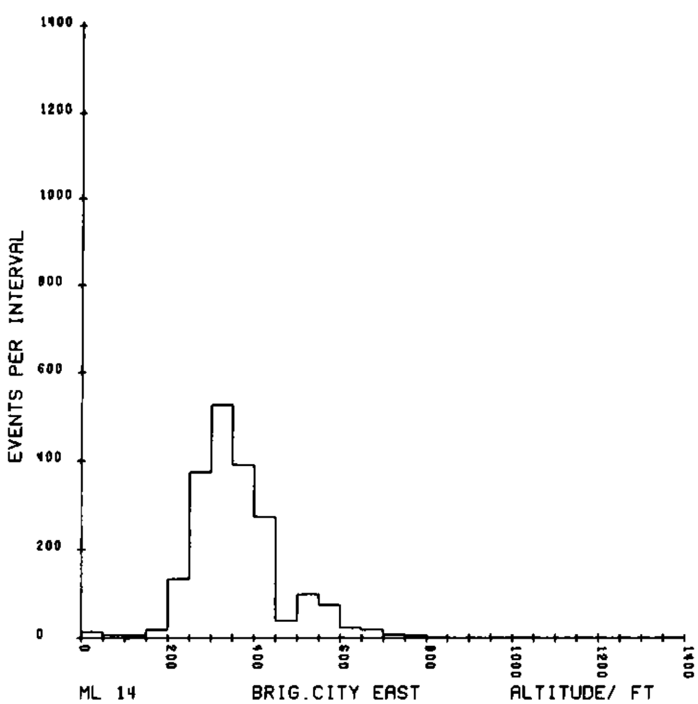
ML 14 BRIG.CITY WEST ALTITUDE/ FT



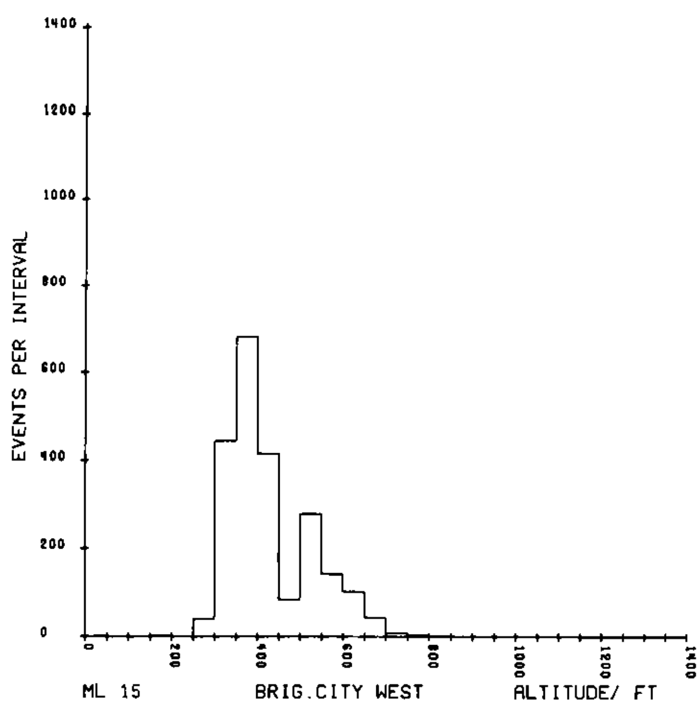
EVENTS PER INTERVAL
ML 14
BRIG.CITY EAST
SPEED IN MPH



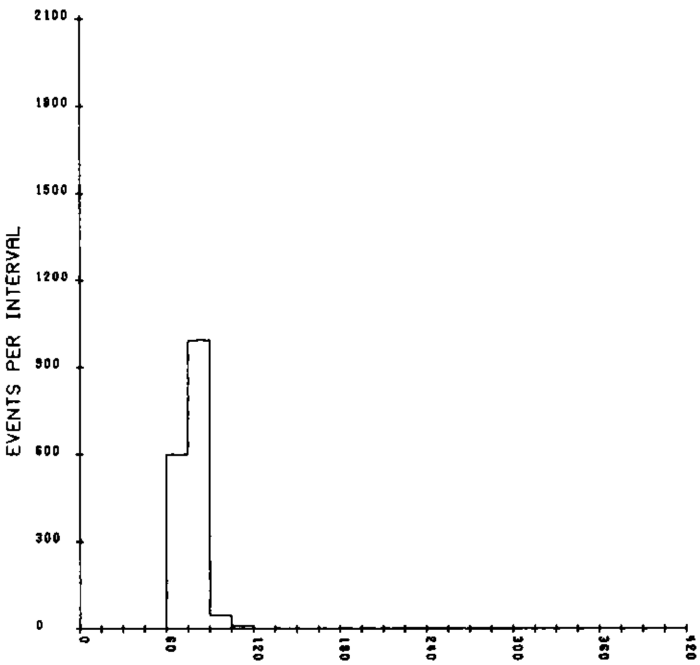
EVENTS PER INTERVAL
ML 15
BRIG.CITY WEST
SPEED IN MPH



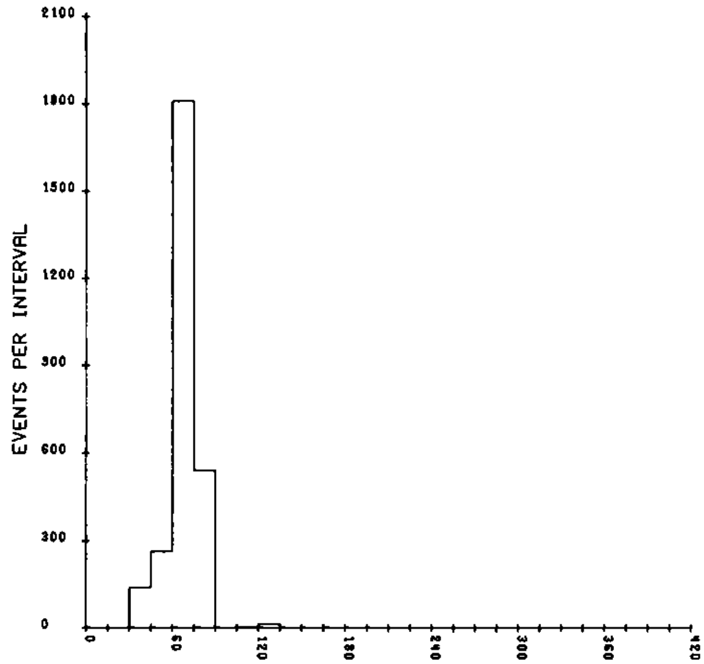
EVENTS PER INTERVAL
ML 14
BRIG.CITY EAST
ALTITUDE/ FT



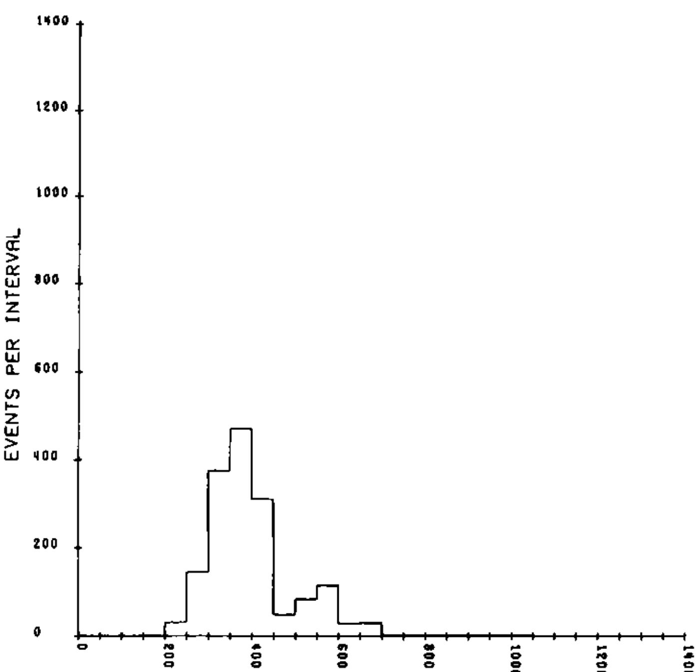
EVENTS PER INTERVAL
ML 15
BRIG.CITY WEST
ALTITUDE/ FT



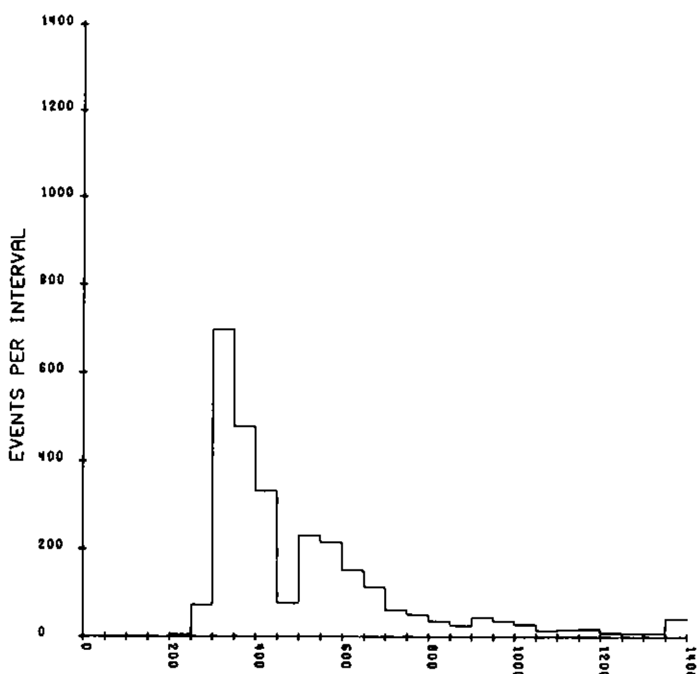
ML 15 BRIG.CITY EAST SPEED IN MPH



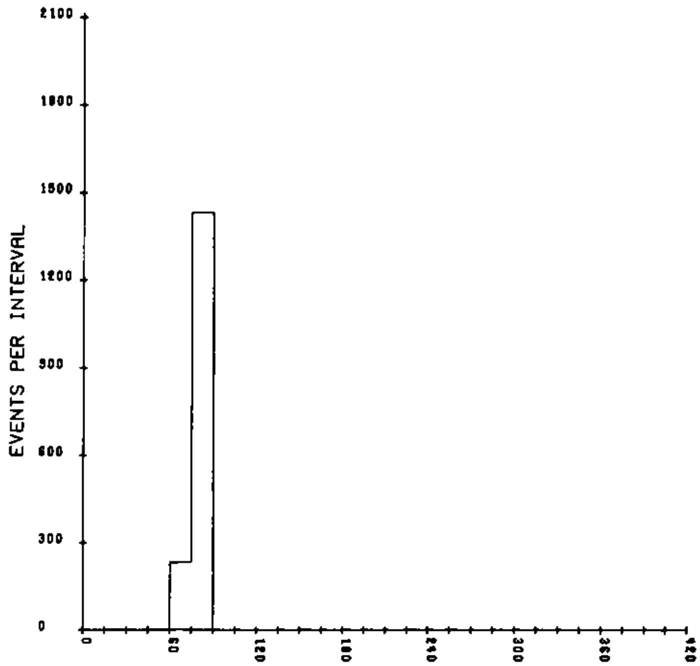
ML 16 BRIG.CITY WEST SPEED IN MPH



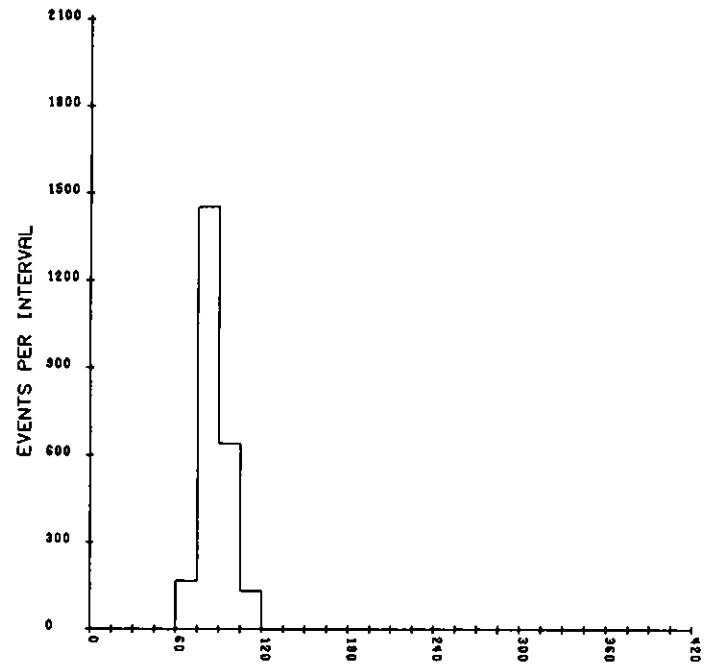
ML 15 BRIG.CITY EAST ALTITUDE/ FT



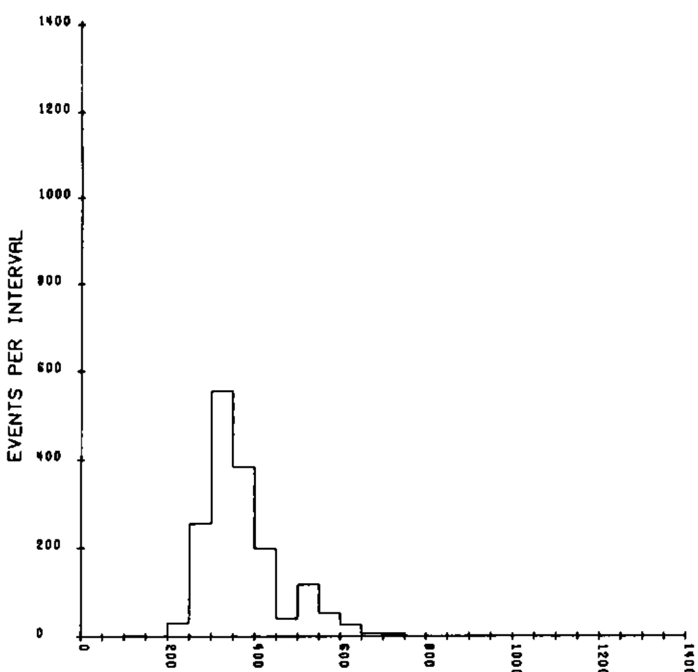
ML 16 BRIG.CITY WEST ALTITUDE/ FT



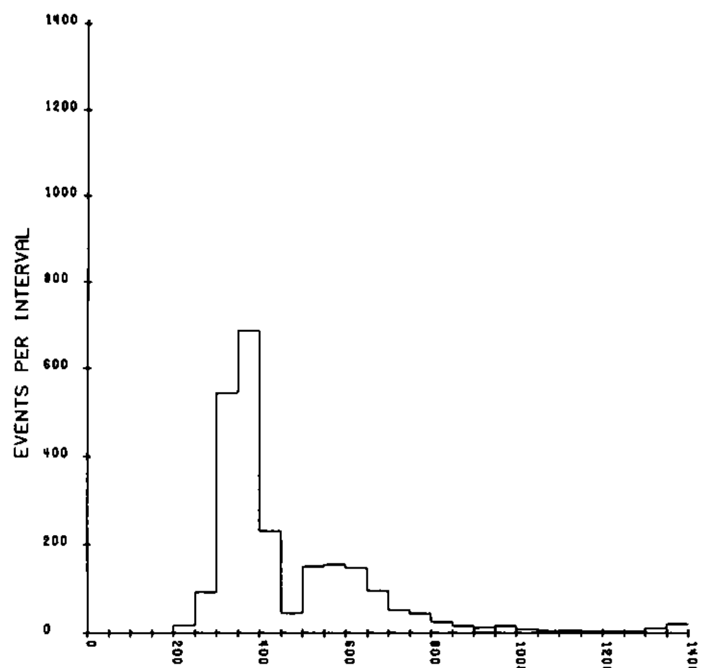
ML 16 BRIG.CITY EAST SPEED IN MPH



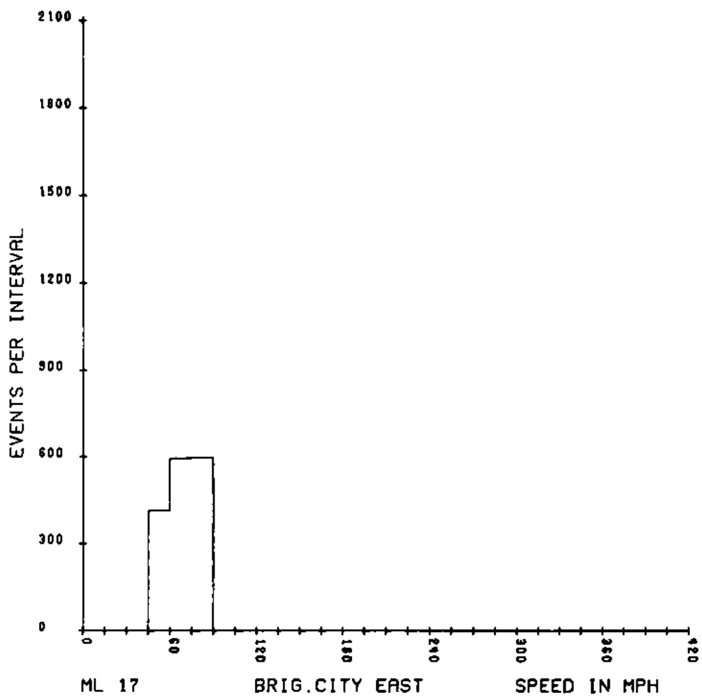
ML 17 BRIG.CITY WEST SPEED IN MPH

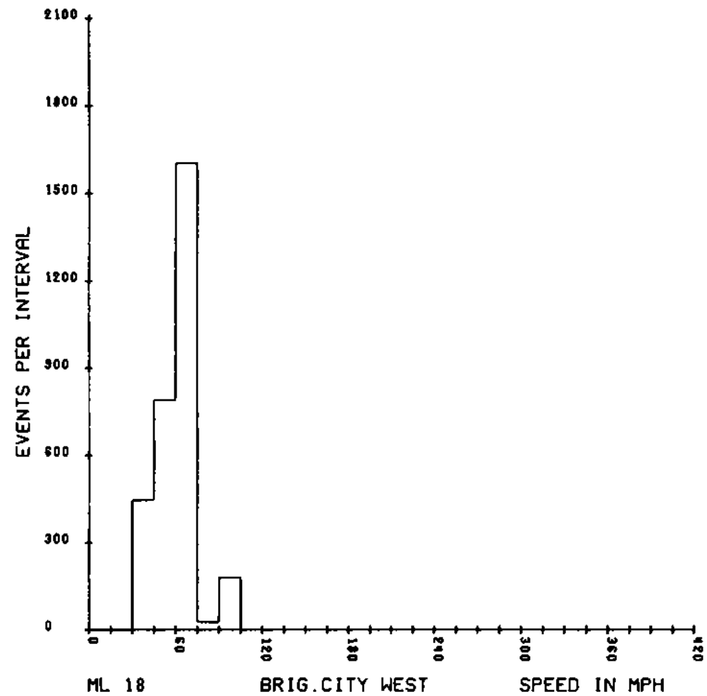


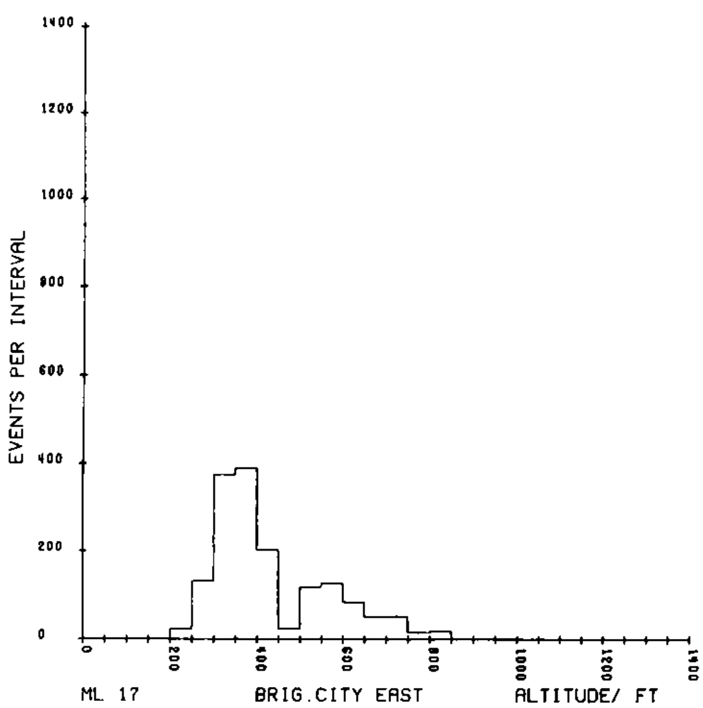
ML 16 BRIG.CITY EAST ALTITUDE/ FT

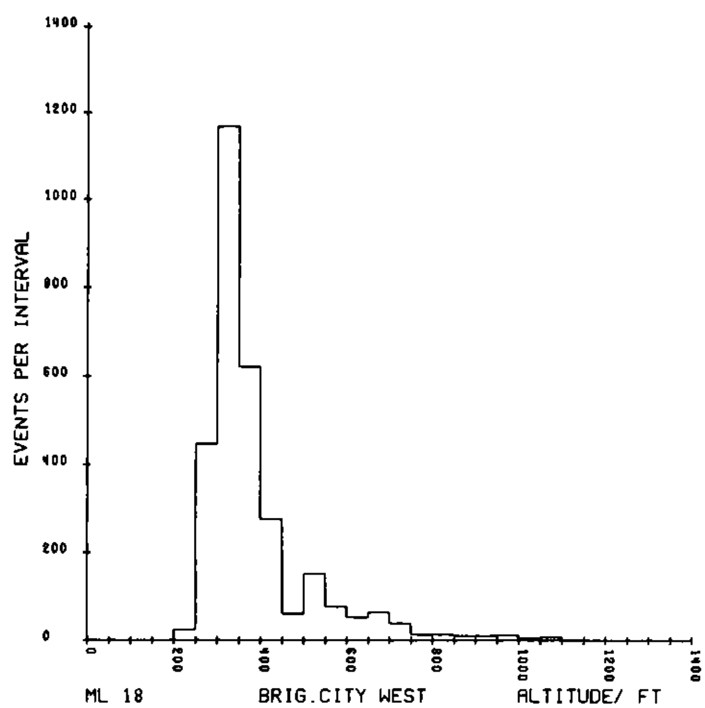


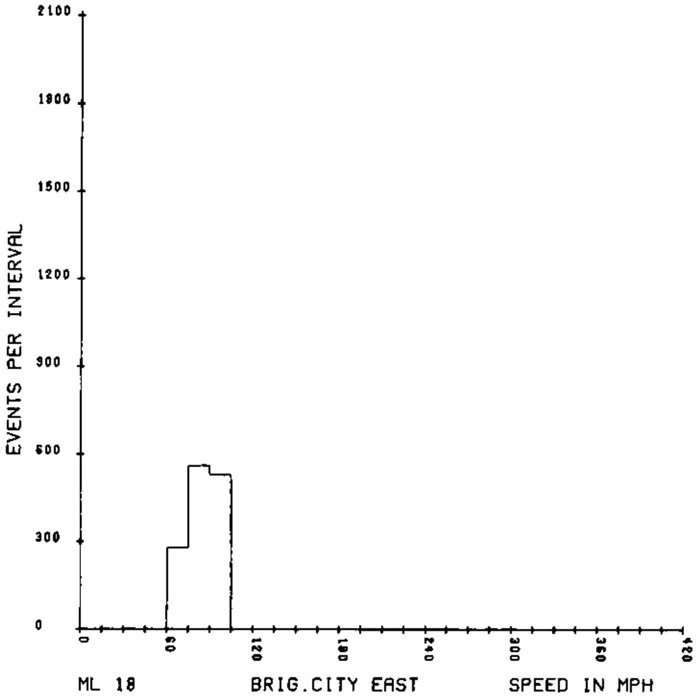
ML 17 BRIG.CITY WEST ALTITUDE/ FT

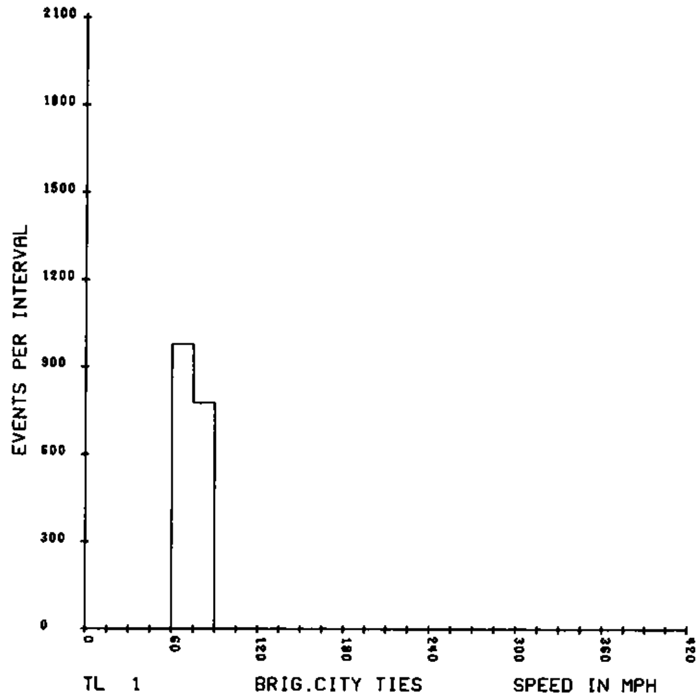

EVENTS PER INTERVAL
2100
1800
1500
1200
900
600
300
0
60
120
180
240
300
360
420
ML 17
BRIG.CITY EAST
SPEED IN MPH

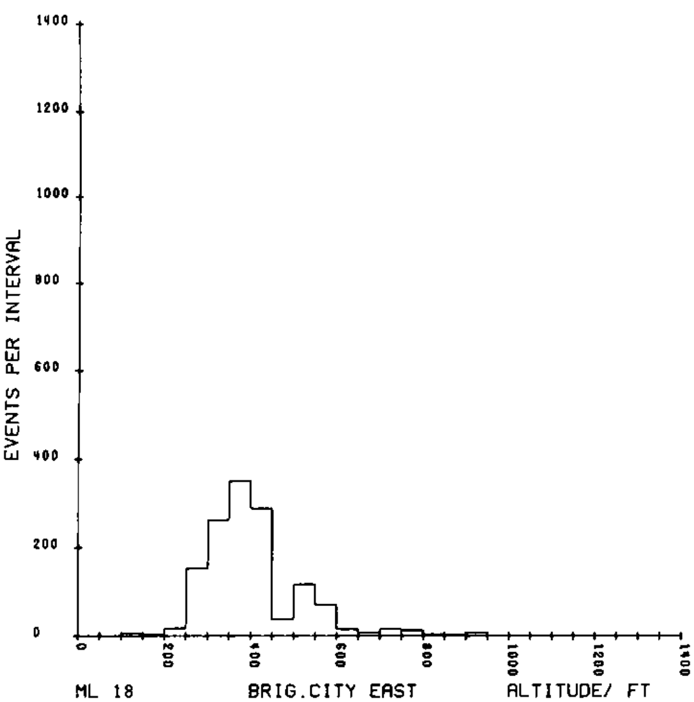

EVENTS PER INTERVAL
2100
1800
1500
1200
900
600
300
0
60
120
180
240
300
360
420
ML 18
BRIG.CITY WEST
SPEED IN MPH

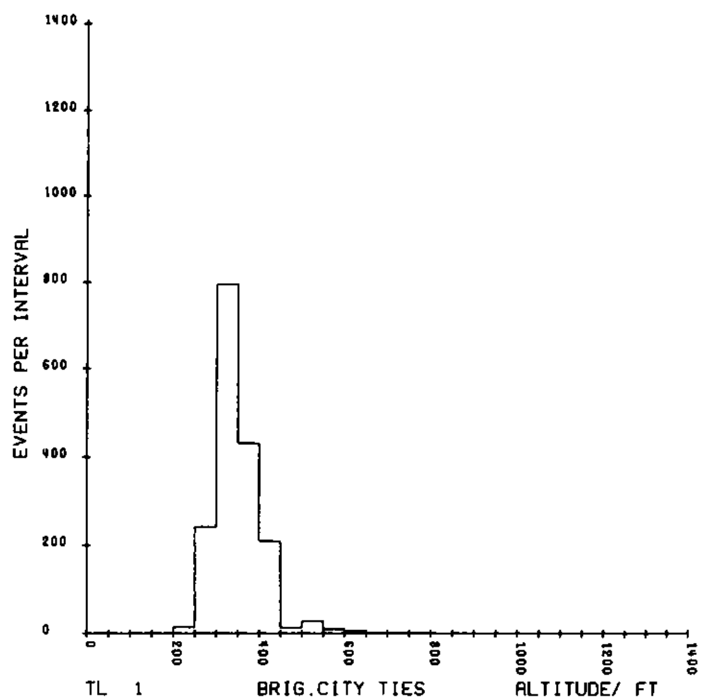

EVENTS PER INTERVAL
1400
1200
1000
800
600
400
200
0
200
400
600
800
1000
1200
1400
ML 17
BRIG.CITY EAST
ALTITUDE/ FT

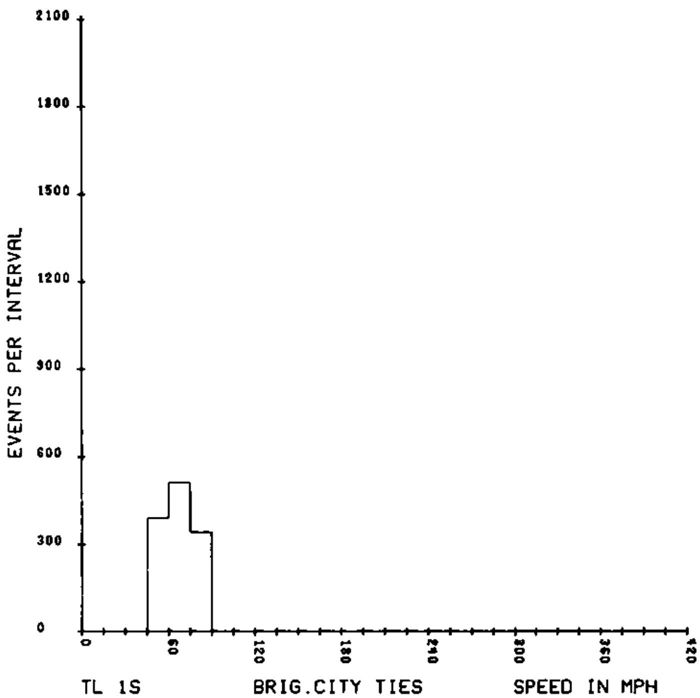

EVENTS PER INTERVAL
1400
1200
1000
800
600
400
200
0
200
400
600
800
1000
1200
1400
ML 18
BRIG.CITY WEST
ALTITUDE/ FT

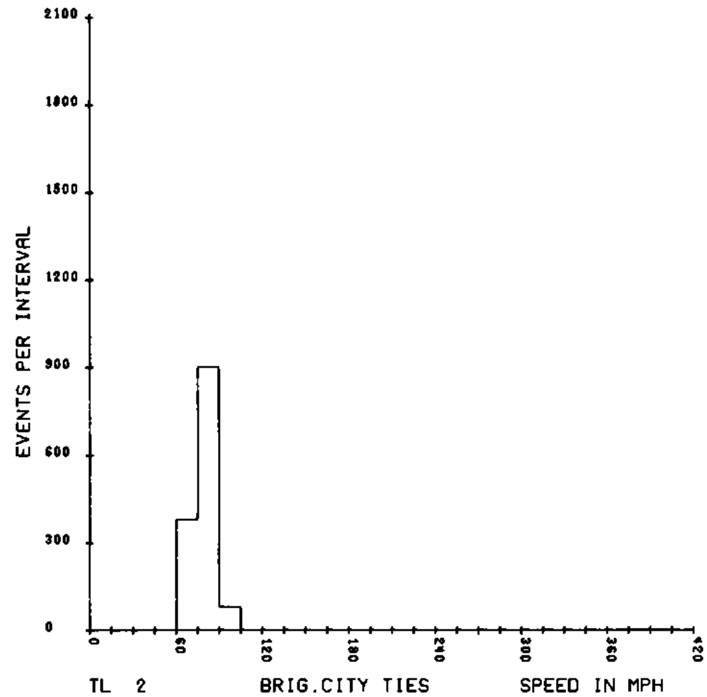

EVENTS PER INTERVAL
2100
1800
1500
1200
900
600
300
0
0
60
120
180
240
300
360
420
ML 18
BRIG.CITY EAST
SPEED IN MPH

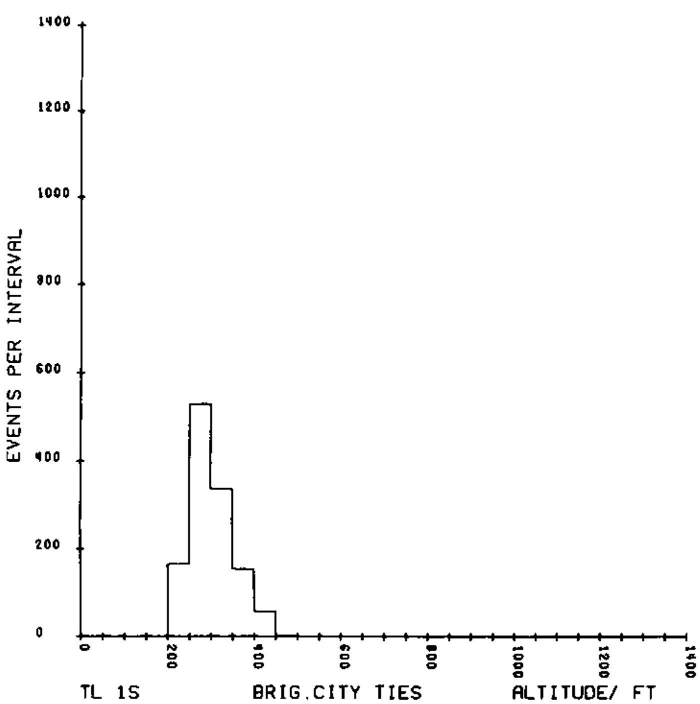

EVENTS PER INTERVAL
2100
1800
1500
1200
900
600
300
0
0
60
120
180
240
300
360
420
TL 1
BRIG.CITY TIES
SPEED IN MPH

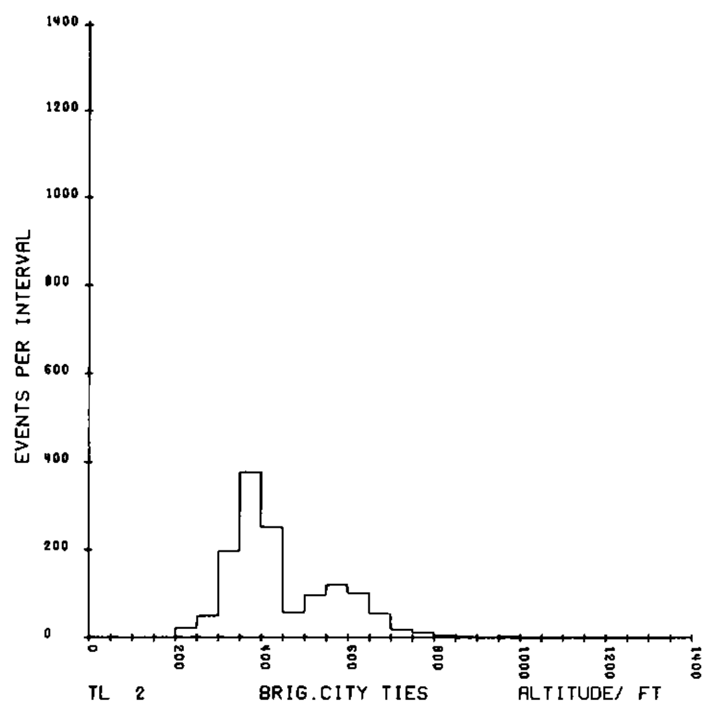

EVENTS PER INTERVAL
1400
1200
1000
800
600
400
200
0
0
200
400
600
800
1000
1200
1400
ML 18
BRIG.CITY EAST
ALTITUDE/ FT

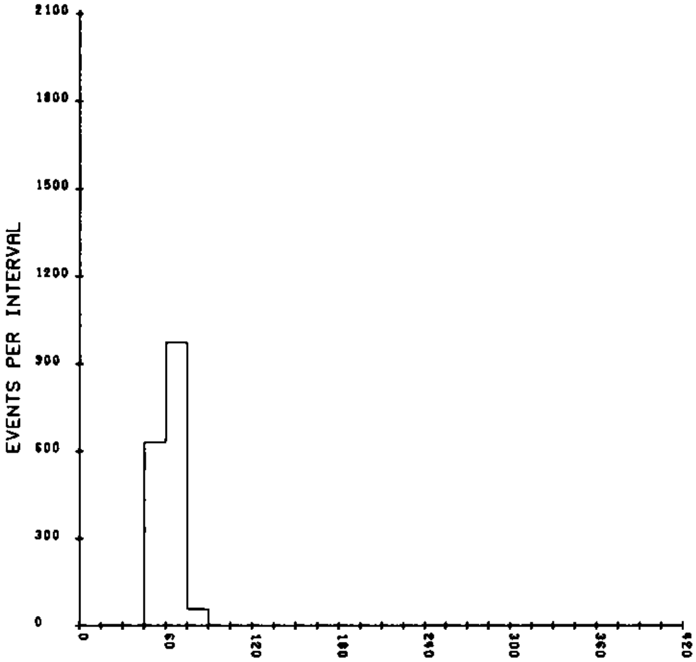

EVENTS PER INTERVAL
1400
1200
1000
800
600
400
200
0
0
200
400
600
800
1000
1200
1400
TL 1
BRIG.CITY TIES
ALTITUDE/ FT


EVENTS PER INTERVAL
2100
1800
1500
1200
900
600
300
0
0
60
120
180
240
300
360
420
TL 1S
BRIG.CITY TIES
SPEED IN MPH

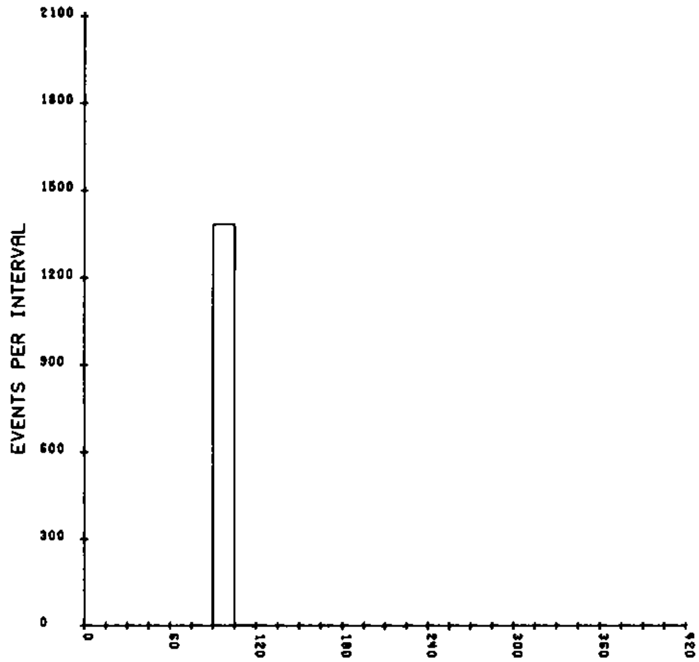

EVENTS PER INTERVAL
2100
1800
1500
1200
900
600
300
0
0
60
120
180
240
300
360
420
TL 2
BRIG.CITY TIES
SPEED IN MPH


EVENTS PER INTERVAL
1400
1200
1000
800
600
400
200
0
0
200
400
600
800
1000
1200
1400
TL 1S
BRIG.CITY TIES
ALTITUDE/ FT

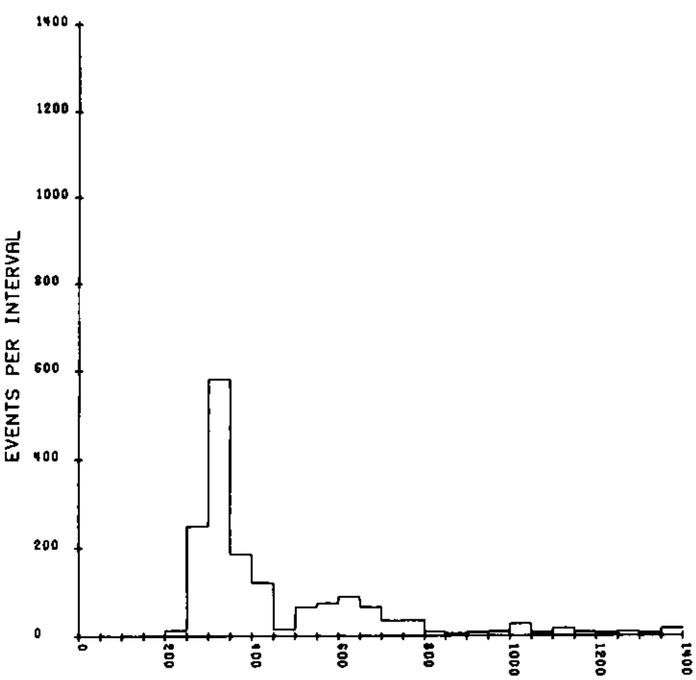

EVENTS PER INTERVAL
1400
1200
1000
800
600
400
200
0
0
200
400
600
800
1000
1200
1400
TL 2
BRIG.CITY TIES
ALTITUDE/ FT



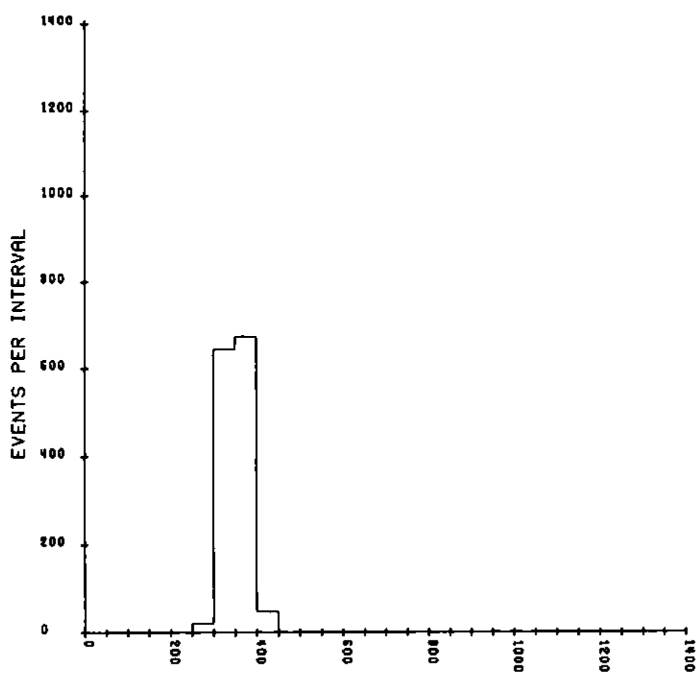
TL 3 BRIG.CITY TIES SPEED IN MPH



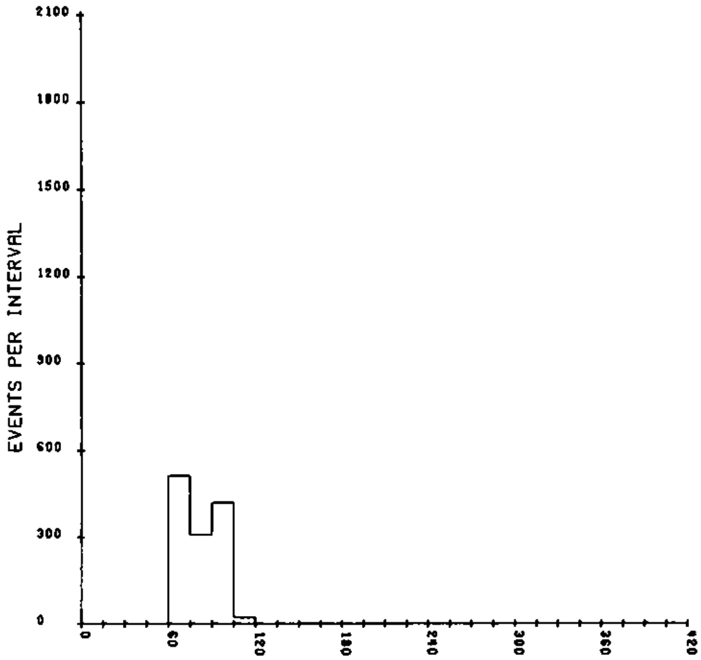
TL 3S BRIG.CITY TIES SPEED IN MPH



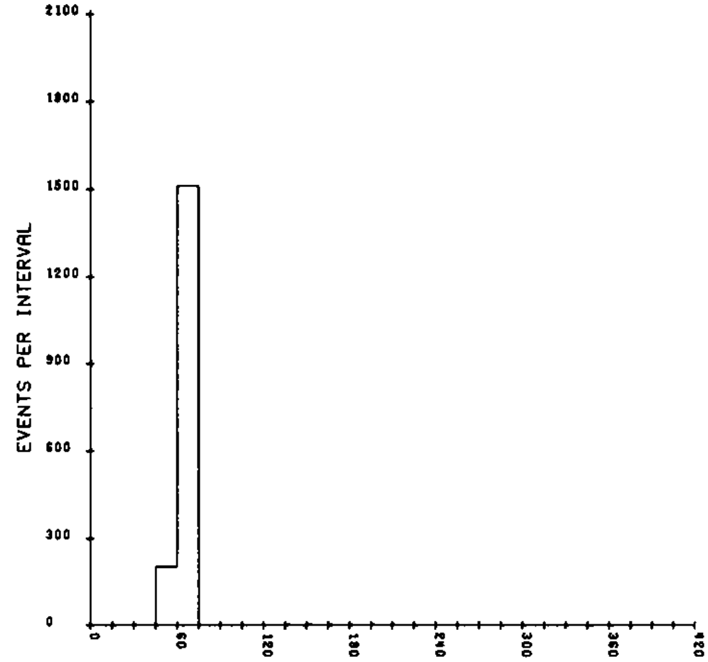
TL 3 BRIG.CITY TIES ALTITUDE/ FT



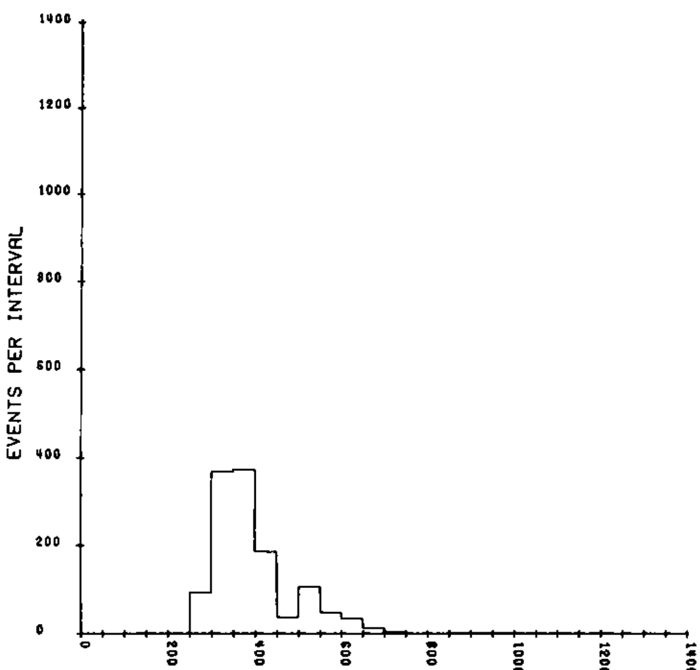
TL 3S BRIG.CITY TIES ALTITUDE/ FT



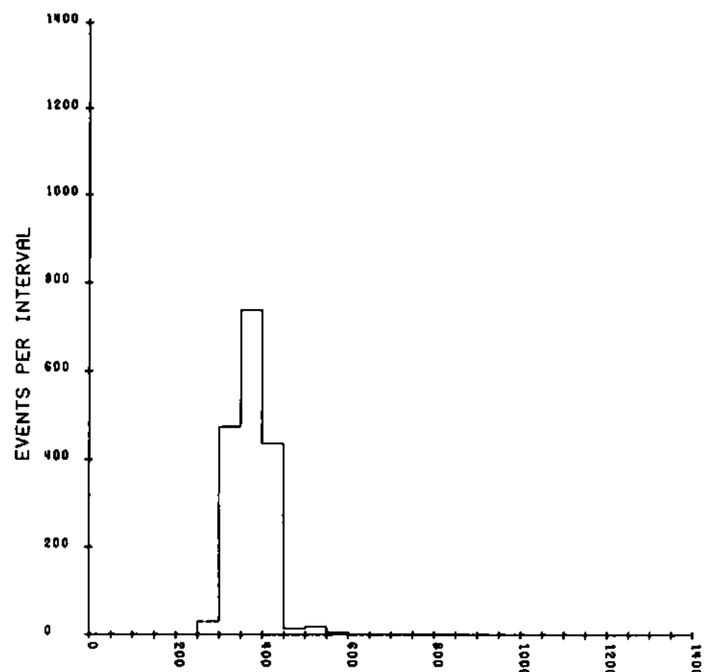
TL 4 BRIG.CITY TIES SPEED IN MPH



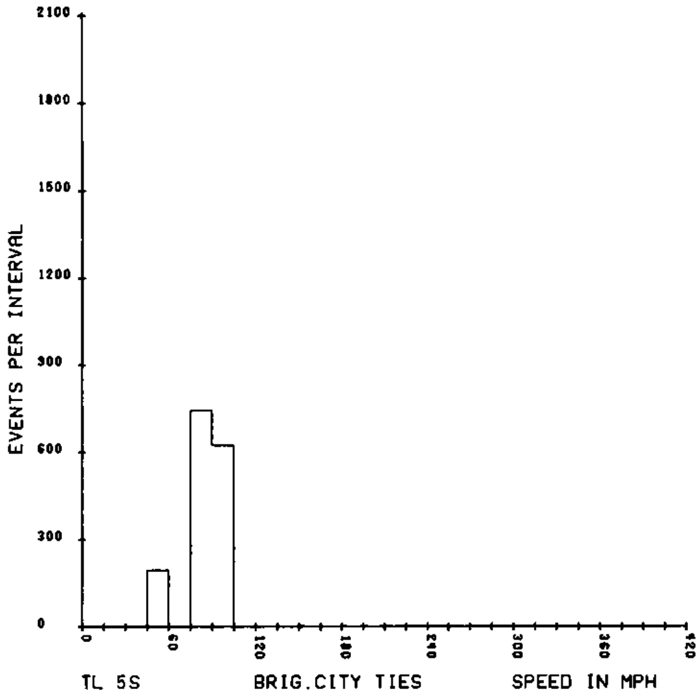
TL 5 BRIG.CITY TIES SPEED IN MPH



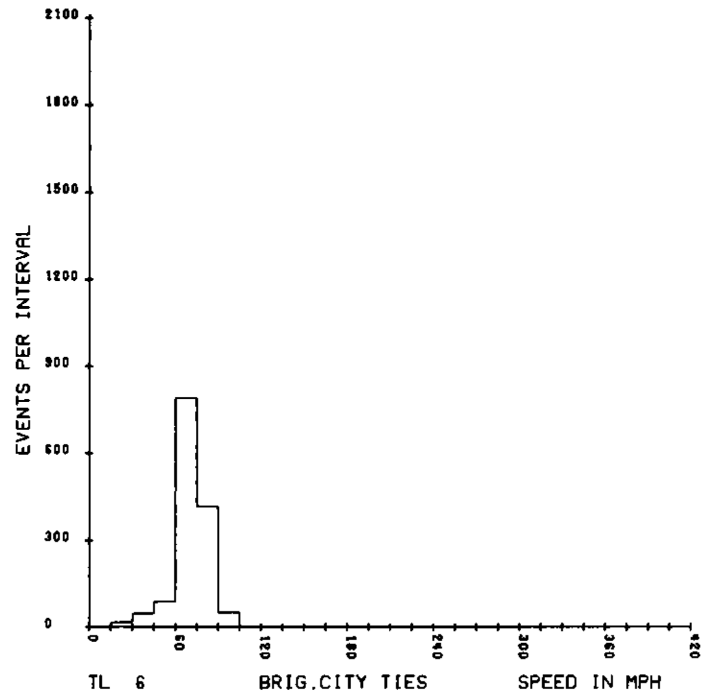
TL 4 BRIG.CITY TIES ALTITUDE/ FT



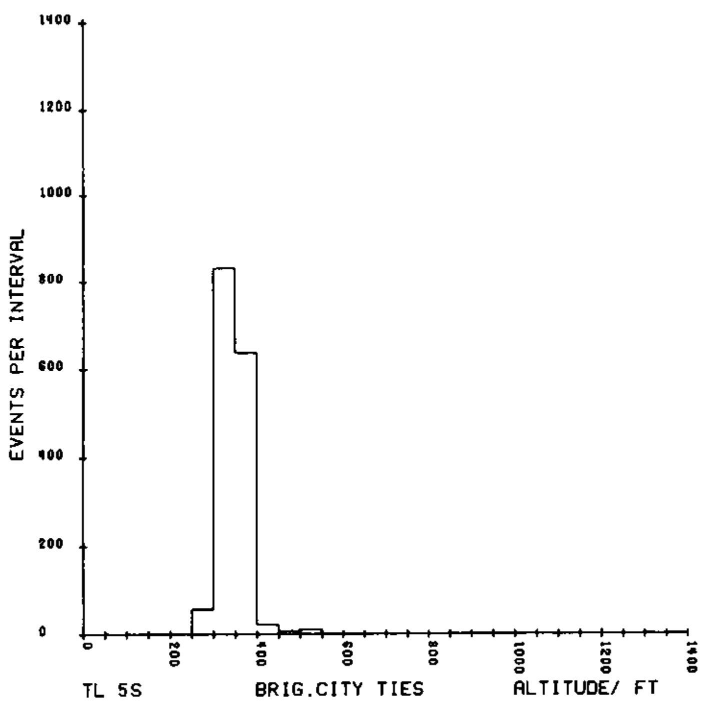
TL 5 BRIG.CITY TIES ALTITUDE/ FT



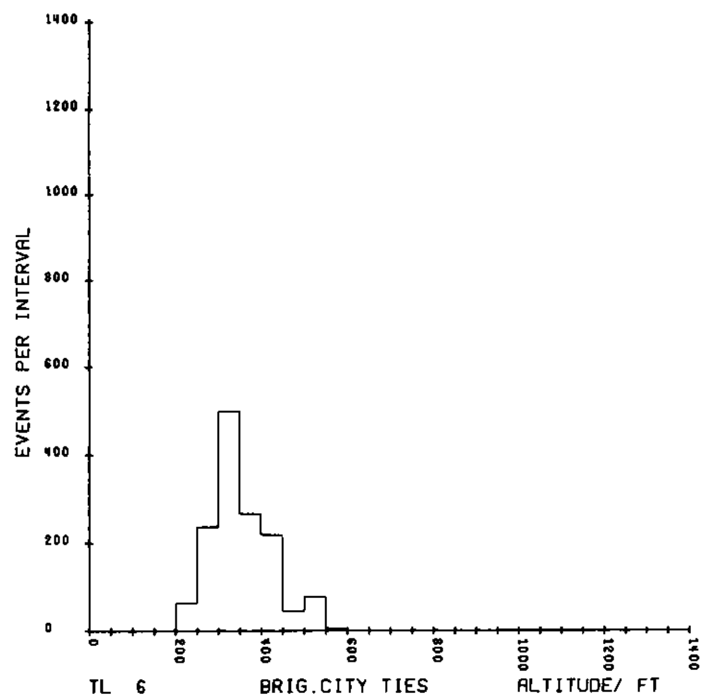
EVENTS PER INTERVAL
TL 5S
BRIG.CITY TIES
SPEED IN MPH



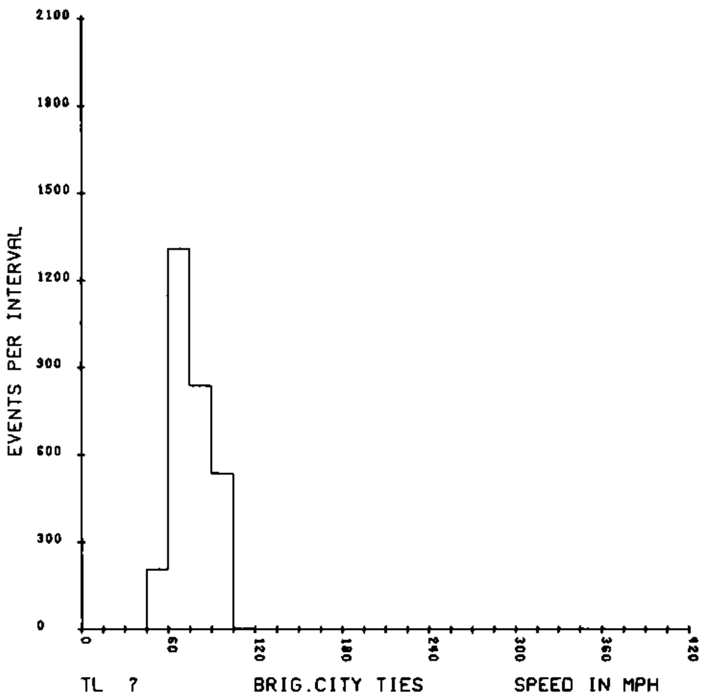
EVENTS PER INTERVAL
TL 6
BRIG.CITY TIES
SPEED IN MPH

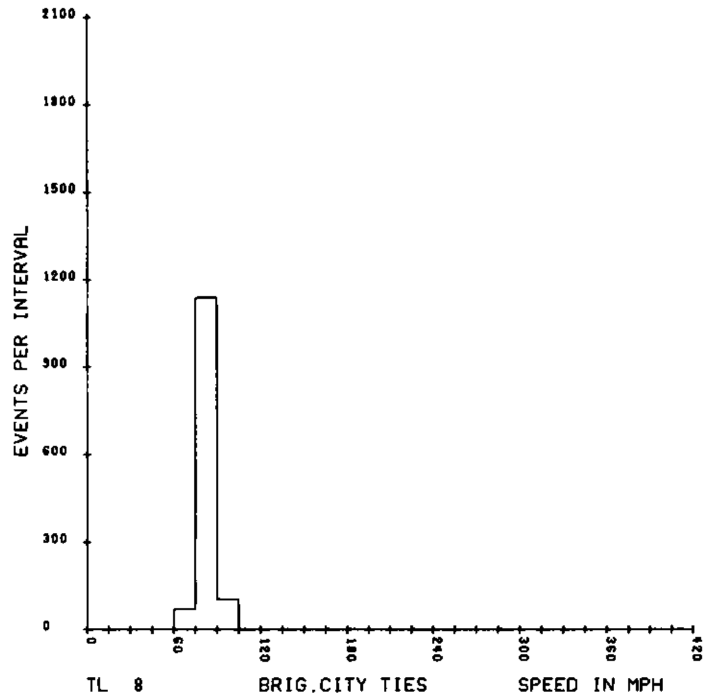


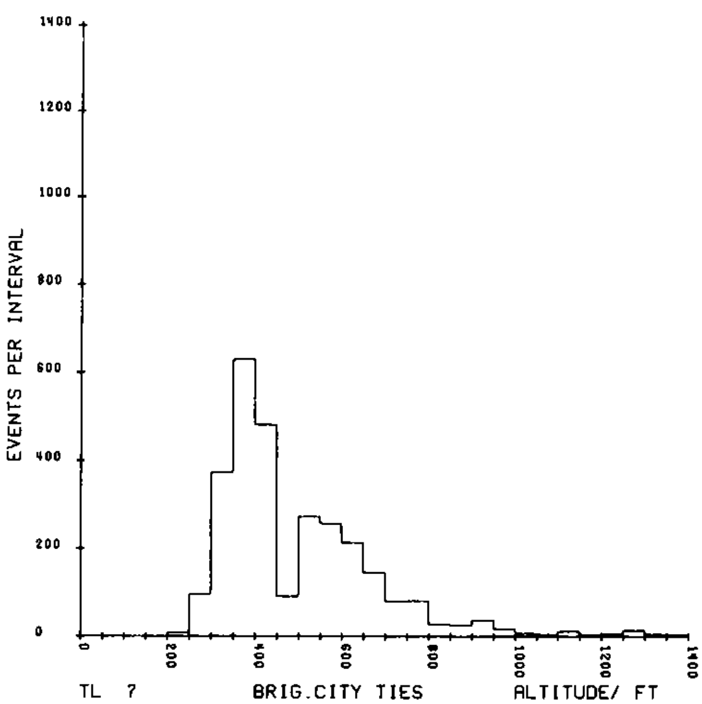
EVENTS PER INTERVAL
TL 5S
BRIG.CITY TIES
ALTITUDE/ FT

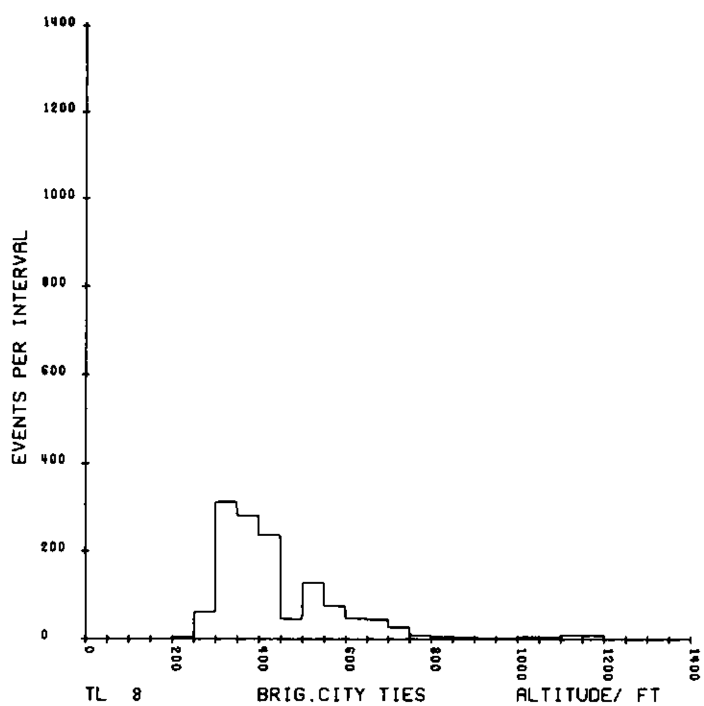


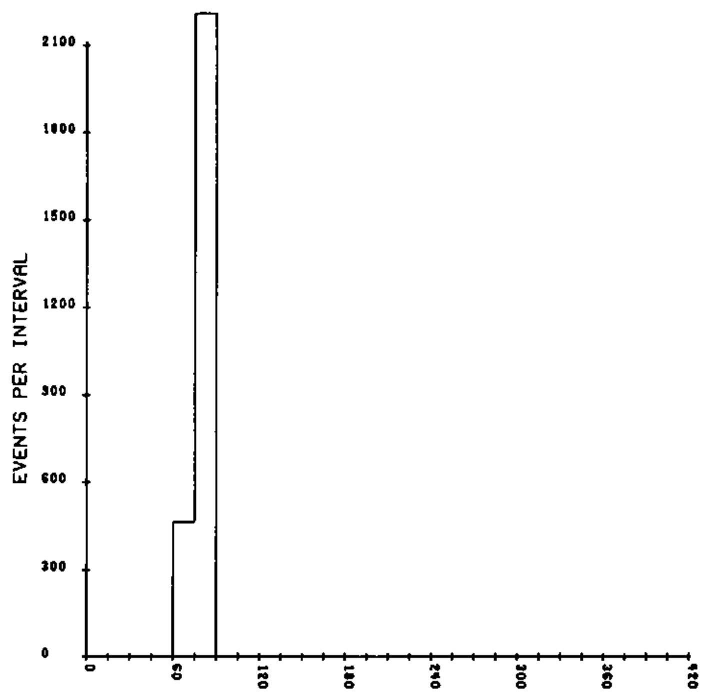
EVENTS PER INTERVAL
TL 6
BRIG.CITY TIES
ALTITUDE/ FT


EVENTS PER INTERVAL
0
300
600
900
1200
1500
1800
2100
0
60
120
180
240
300
360
420
TL 7
BRIG.CITY TIES
SPEED IN MPH

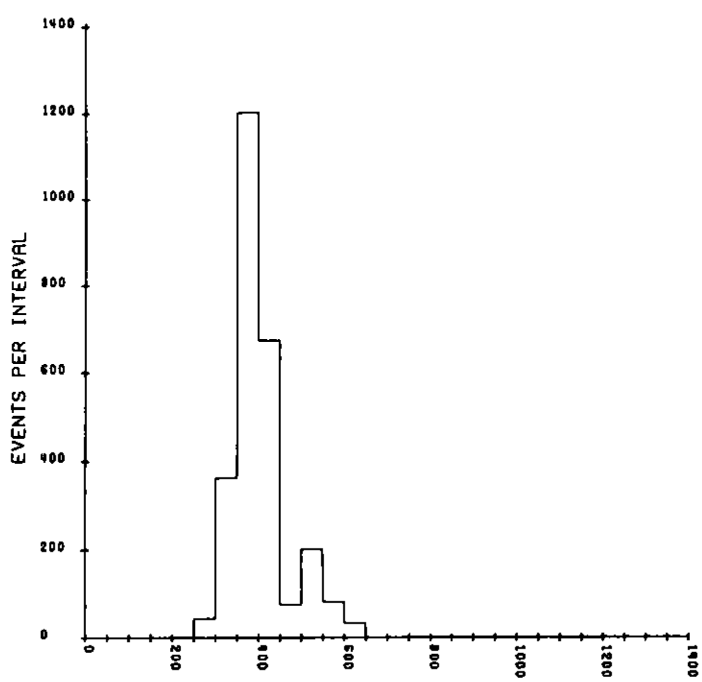

EVENTS PER INTERVAL
0
300
600
900
1200
1500
1800
2100
0
60
120
180
240
300
360
420
TL 8
BRIG.CITY TIES
SPEED IN MPH


EVENTS PER INTERVAL
0
200
400
600
800
1000
1200
1400
0
200
400
600
800
1000
1200
1400
TL 7
BRIG.CITY TIES
ALTITUDE/ FT


EVENTS PER INTERVAL
0
200
400
600
800
1000
1200
1400
0
200
400
600
800
1000
1200
1400
TL 8
BRIG.CITY TIES
ALTITUDE/ FT



TL 9 BRIG.CITY TIES SPEED IN MPH



TL 9 BRIG.CITY TIES ALTITUDE/ FT

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