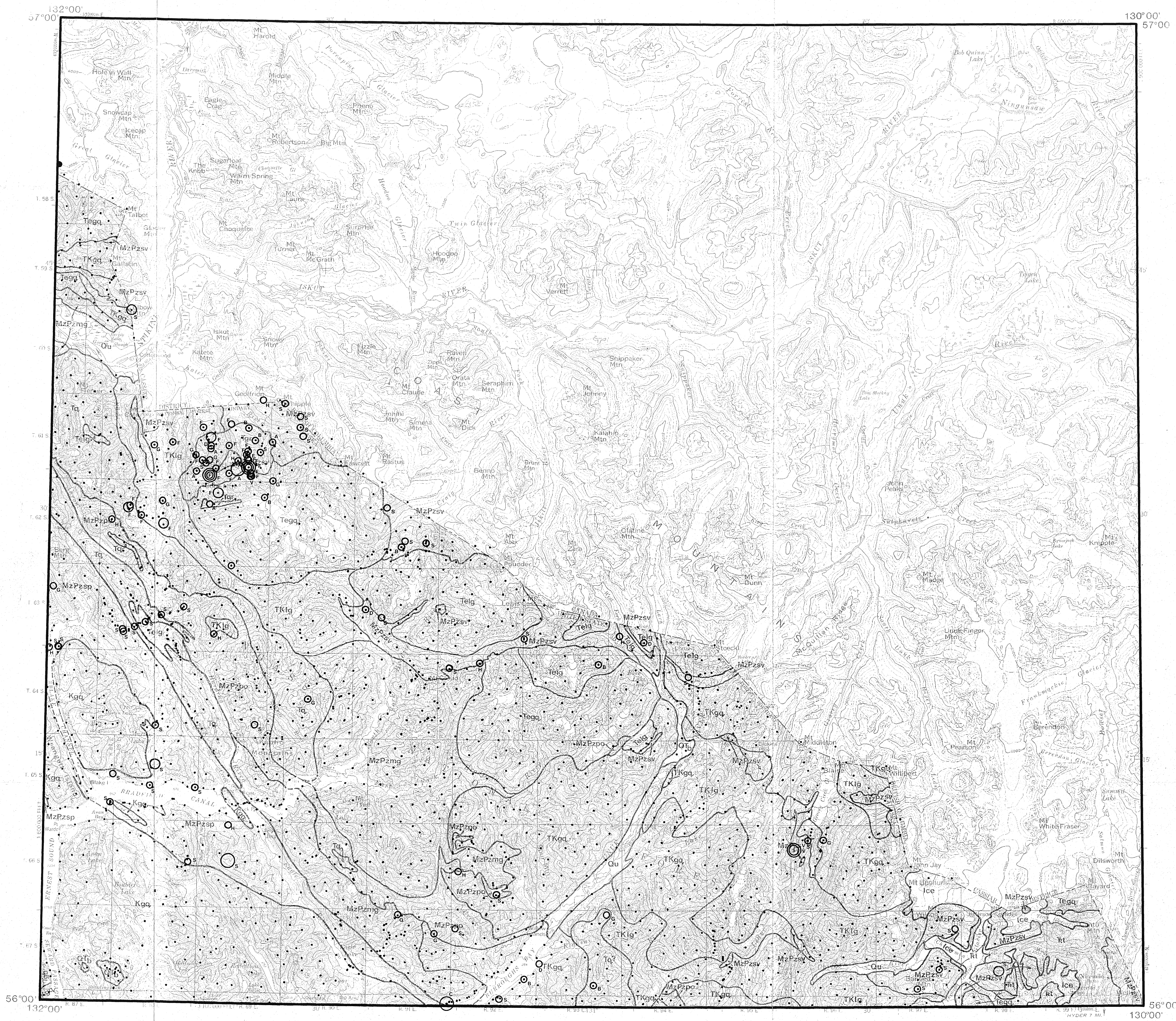
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

OPEN-FILE REPORT
81-728-E
SHEET 1 OF 4
FOLIO OF THE BRADFIELD CANAL QUADRANGLE, ALASKA
KOCH AND ELLIOTT-GEOCHEMISTRY-Pb

LEAD IN ROCK SAMPLES
(atomic-absorption determinations)

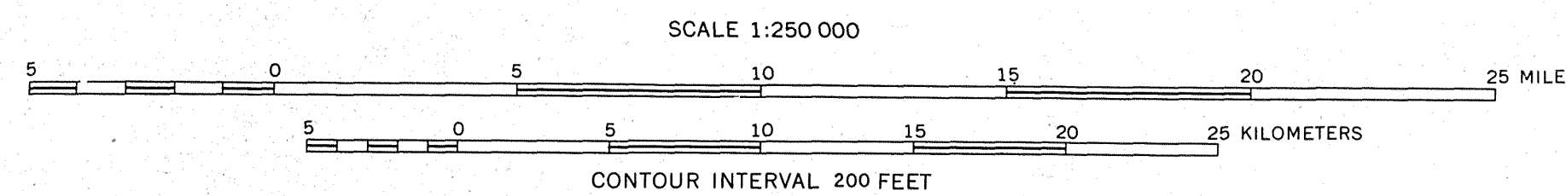


ROCK SAMPLES

Base from USGS 1:250,000 topo series:
Bradfield Canal, 1955, ALASKA-CANADA.

Geology by H. C. Berg, D. A. Brew, A. L. Clark, W. H. Condon, J. E. Decker, M. F. Diggles, G. C. Dunne, R. L. Elliott, J. D. Gallinatti, M. H. Herdrick, S. M. Karl, R. D. Koch, M. L. Miller-Hoare, R. P. Morrell, J. G. Smith, and R. A. Sonnevil, 1968-1979.

SCALE 1:250 000



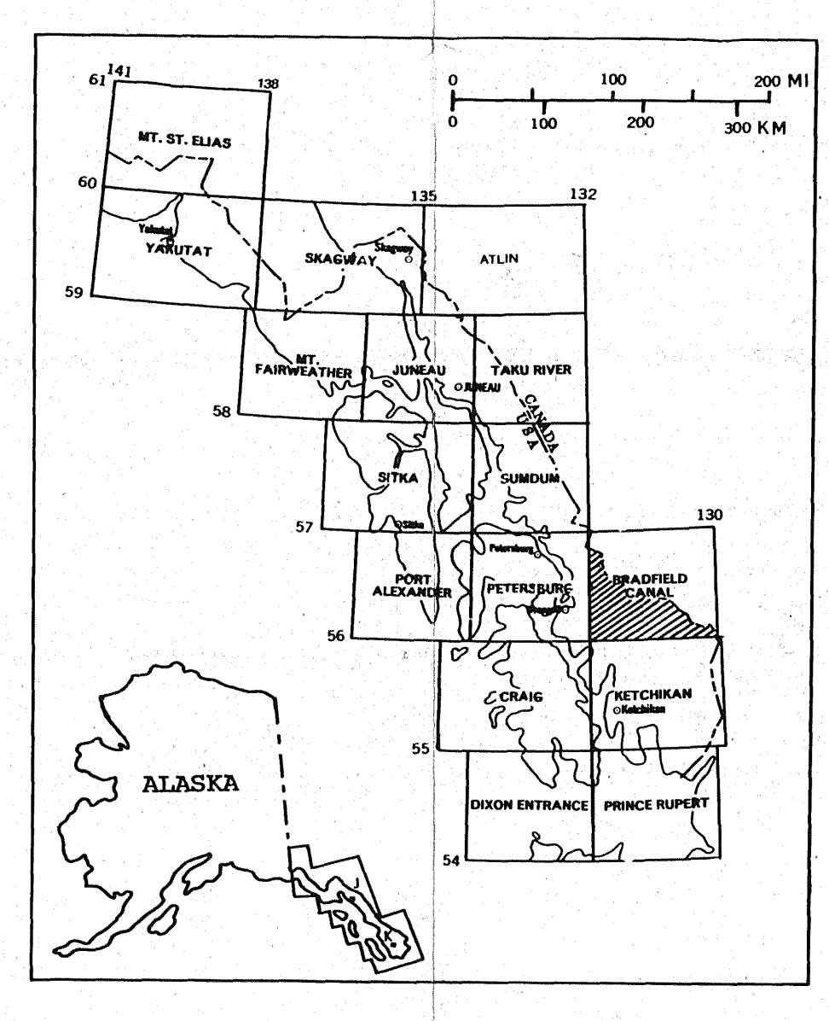
CONTOUR INTERVAL 200 FEET
DATUM IS MEAN SEA LEVEL

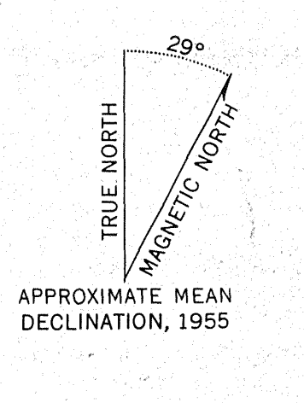
KEY TO LITHOLOGY GROUP SYMBOLS

- A - ALKALI-FELDSPAR GRANITE - includes related dikes
- B - BASALT and ANDESITE - includes dikes and flows, and lamprophyre dikes
- C - CALCSILICATE and SKARN
- D - DIORITE and GABBRO - includes minor metadiorite, hornblendite, and ultramafic rocks
- F - FELSITE - some quartz-porphyritic. Includes dikes, flows(?), and breccias
- G - GRANITIC ROCKS - mainly massive and foliated quartz monzonite, granodiorite, and quartz diorite, with lesser alaskite, aplite, and pegmatite
- H - HORNBLENDE-RICH SCHIST and GNEISS - includes amphibolite, greenschist, and other mafic metamorphic rocks
- M - MIGMATITE and ORTHOGNEISS - includes granitic gneiss (eg: granodiorite gneiss, quartz diorite gneiss, etc.)
- S - SCHIST and GNEISS - mainly pelitic and quartzofeldspathic schist and gneiss, and lesser non-schistose metasedimentary rocks
- V - VEINS

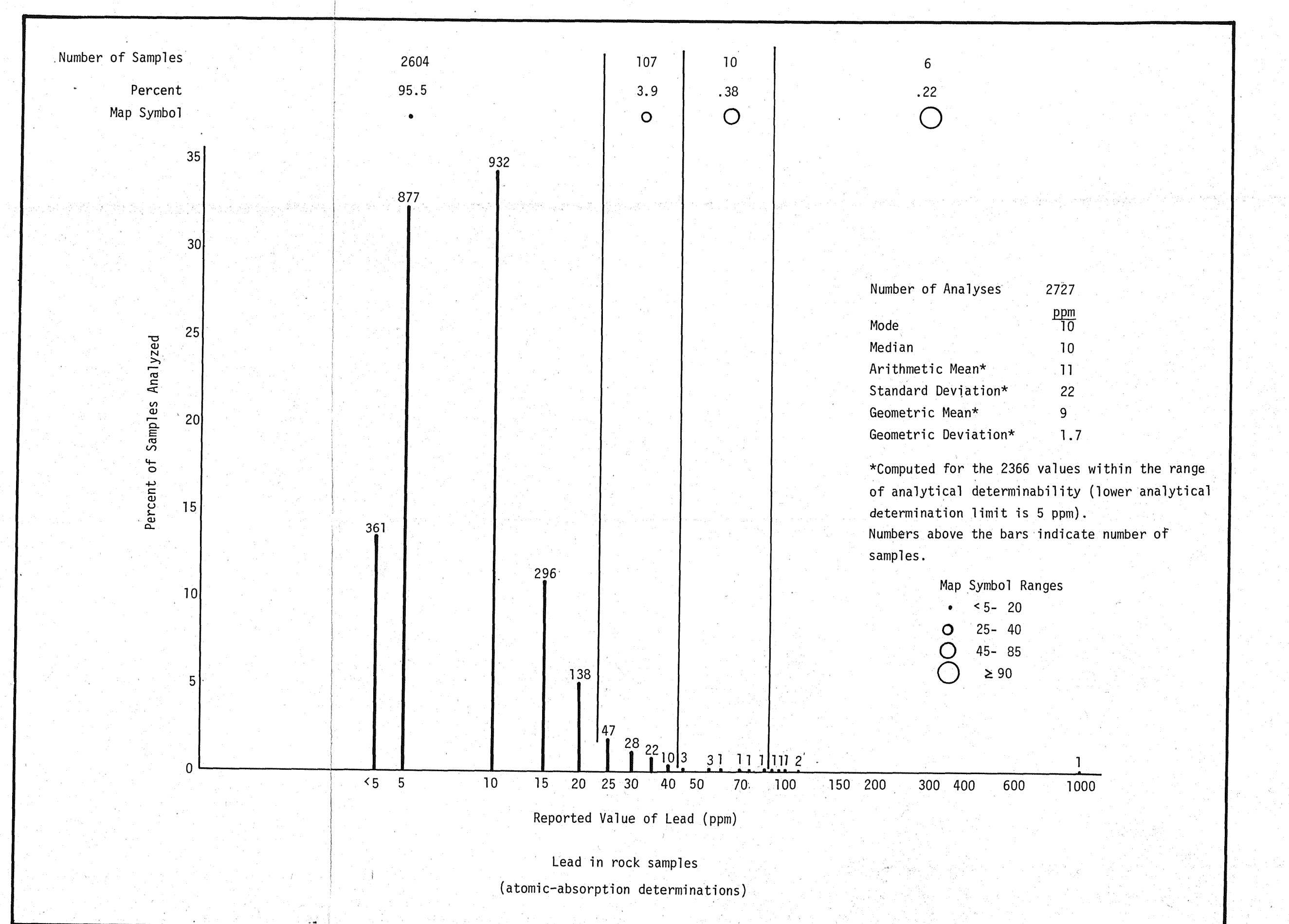
Unit Descriptions

Qu	UNCONSOLIDATED DEPOSITS, UNDIVIDED (Quaternary)
QT_b	BASALT (Quaternary and Tertiary?)
Tgr	ALKALI-FELDSPAR GRANITE WITH ASSOCIATED QUARTZ-PORPHYRITIC RHYOLITE DIKES AND FLOWS(?) (Miocene?)
Tgb	BIOTITE-PYROXENE GABBRO, LOCALLY CONTAINS HORNBLENDE AND/OR OLIVINE (Miocene)
Telg	LEUCOCRATIC QUARTZ MONZONITE AND GRANODIORITE (Eocene)
Tegq	GRANODIORITE AND QUARTZ DIORITE (Eocene)
Tq	QUARTZ DIORITE (Eocene or Paleocene)
TKlg	LEUCOCRATIC QUARTZ MONZONITE AND GRANODIORITE (Tertiary and/or Cretaceous)
TKgq	GRANODIORITE AND QUARTZ DIORITE (Tertiary and/or Cretaceous)
Kgq	BIOTITE-HORNBLENDE QUARTZ DIORITE, PLAGIOCLASE-PORPHYRITIC BIOTITE GRANODIORITE/QUARTZ DIORITE, BOTH LOCALLY CONTAIN GARNET AND/OR EPIDOTE (Cretaceous)
₨t	TEXAS CREEK GRANODIORITE (Triassic)
MzPzmg	MIGMATITE AND ORTHOGNEISS, WITH LESSER PARAGNEISS (Mesozoic and/or Paleozoic)
MzPzpo	PARAGNEISS AND ORTHOGNEISS, WITH LESSER AMPHIBOLITE AND MARBLE (Mesozoic and/or Paleozoic)
MzPzsp	SCHIST AND PARAGNEISS, WITH LESSER AMPHIBOLITE AND MARBLE (Mesozoic and/or Paleozoic)
MzPzsv	METASEDIMENTARY AND LESSER METAVOLCANIC ROCKS, WITH LOCAL MARBLE (Mesozoic and/or Paleozoic)





APPROXIMATE MEAN DECLINATION, 1955



Lead in rock samples
(atomic-absorption determinations)

Discussion

During U.S. Geological Survey investigations in the Bradfield Canal quadrangle between 1968 and 1979, 2784 rock geochemical samples, 1295 stream-sediment samples, and 219 stream-sediment heavy-mineral concentrate samples were collected. The samples were analyzed for up to 31 elements by a 6-step, semi-quantitative emission spectrographic method (Grimes and Marranzino, 1968) and for up to 5 elements by atomic-absorption techniques (Ward and others, 1969). Complete analytical data for all samples, plus location maps, station coordinates, and a discussion of sampling and analytical procedures are available in 3 reports (Koch and others, 1980a,b,c). These data are also available on magnetic computer tape (Koch, O'Leary, and Risoli, 1980).

Maps on this and the accompanying sheets show the amounts of lead (Pb) detected in all geochemical samples collected in the Bradfield Canal quadrangle. Lead analyses for most samples were done by both the 6-step spectrographic and the atomic-absorption methods. The spectrographic analytical values are reported as the approximate midpoints of geometrically spaced class intervals, with values in the series 1, 1.5, 2, 3, 5, 7, 10, 15, 20, ... (see Koch and others, 1980a,b,c, Grimes and Marranzino, 1968). Each of these reporting values is referred to as a "step" on the reporting scale. Analytical values from atomic-absorption analyses are reported at intervals of 5 ppm for values between 5 and 100 ppm, and at intervals of 10 ppm for values above 100 ppm.

Spectrographic and atomic-absorption analytical results for Pb tend to be somewhat different, with the spectrographic values averaging two steps higher for rock samples, and almost 2 steps higher for stream-sediment and stream-sediment heavy-mineral spectrographic values. About 90 percent of the spectrographic values are between one step lower and 6 steps higher than the corresponding atomic-absorption value for rock samples, one step lower and 4 steps higher for stream-sediment samples, and 0 steps lower and 4 steps higher for heavy-mineral concentrates. The sources of these differences have not been rigorously identified, but several factors probably contribute.

Atomic-absorption analyses have lower analytical determination limits and are considered to have greater precision than the spectrographic analyses (Richard M. O'Leary, pers. comm., 1980, Koch and others, 1980a,b,c, Motooka and Grimes, 1976). The nitric acid partial digestion used for atomic-absorption analyses dissolves sulfides and oxides, but only extracts metals from the surface of silicate grains. Thermal excitation during spectrographic analysis causes spectral emission from all Pb in the sample. The general shift of spectrographic values higher than atomic-absorption values may thus be partly the result of background levels of Pb in silicates being detected by the spectrographic analysis but not being extracted in the atomic-absorption partial digestion. An additional, nonsystematic source of discrepancy between the analyses may be sample inhomogeneity. Different fractions are used for the two analyses and only a small amount of sample (0.01 g for rock and stream-sediment samples, 0.005 g for concentrate samples) is used for the spectrographic analyses.

Average* abundance of lead (in ppm) in the Earth's crust and various crustal components. (From Levinson, 1974)

	Earth's crust	Ultra-mafic	Basalt	Grano-diorite	Granite	Shale	Lime-stone	Soil
Pb	12.5	0.1	5	15	20	20	8	2-200

*Note: Because the analyses on which these averages are based may not be directly compatible with the analyses used for this report, these figures serve only as a general guide.

SELECTED REFERENCES

Berg, H. C., Elliott, R. L., Smith, J. G., and others, 1977, Mineral resources of the Granite Fiords wilderness study area, Alaska: U.S. Geological Survey Bulletin 1403, 151 p.

Grimes, D. J., and Marranzino, A. P., 1968, Direct-current arc and alternating-current spark emission spectrographic field methods for the semiquantitative analysis of geologic materials: U.S. Geological Survey Circular 591, 6 p.

Koch, R. D., Elliott, R. L., O'Leary, R. M., and Risoli, D. A., 1980a, Trace element data for rock samples from the Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 80-910A, 256 p.

_____, 1980b, Trace element data for stream-sediment samples from the Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 80-910B, 172 p.

_____, 1980c, Trace element data for stream-sediment heavy-mineral concentrate samples from the Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 80-910C, 68 p.

Koch, R D., O'Leary, R. M., and Risoli, D. A., 1980, Magnetic tape containing trace element data for rock, stream-sediment, and stream-sediment heavy-mineral concentrate samples from the Bradfield Canal quadrangle, southeastern Alaska: Menlo Park, California, U.S. Geological Survey Report, 23 p., computer tape. Available from the U.S. Department of Commerce, National Technical Information Service, Springfield VA 22151, as report USGS-GD-80-004 or NTIS-PB81-108641.

Levinson, A. A., 1974, Introduction to exploration geochemistry: Wilmette, Illinois, Allied Publishing Ltd., 614 p.

Motooka, J. M., and Grimes, D. J., 1976, Analytical precision of one-sixth order semiquantitative spectrographic analysis: U.S. Geological Survey Circular 738, 25 p.

Smith, J. G., 1977, Geology of the Ketchikan D-1 and Bradfield Canal A-1 quadrangles, southeastern Alaska: U.S. Geological Survey Bulletin 1425, 49 p.

Ward, F. N., Nakagawa, H. M., Harms, T. F., and Van Sickle, G. H., 1969, Atomic-absorption methods of analysis useful in geochemical exploration: U.S. Geological Survey Bulletin 1289, 45 p.

Average geochemical abundances vary for different lithologies and in different areas. The degree of chemical weathering also affects the elemental abundances, although probably with minor effect in this recently glaciated terrain. Analytical variance and variations in sampling practice limit the repeatability of these results. Complex interactions between these sources of variation make it impossible to select a single threshold value which will discriminate between areas which are barren and areas with potentially valuable mineral concentrations.

In order to estimate which analytical values are sufficiently above general background levels to warrant further interest, the following procedure was followed for each sample type. Histograms of the data were examined for apparent breaks (discontinuities or abrupt changes in level) in the distribution. A cutoff value was selected at an arbitrarily chosen level near the 95th percentile or at a break close to that level when one was present. The geographic distribution of the samples above the cutoff level was examined for clumping and scatter. The cutoff level was adjusted up or down to minimize apparent geographic scatter ("noise").

Samples in which the Pb content was above the cutoff level are marked by one of three sizes of circles. Each circle size represents a range of analytical values, with larger circles indicating higher values. Samples in which the Pb content was below the cutoff level are indicated on the map by dots. The range, number, and percentage of values associated with each map symbol are indicated on the corresponding histogram. Higher values may indicate a greater likelihood of bedrock mineralization, but confidence levels are low for values near analytical limits of determinability, for single-element anomalies, for samples where atomic-absorption and spectrographic results are not both high, and for results not supported by high values in nearby samples.

Each rock sample was assigned to one of ten broad lithologic groups of similar rock types on the basis of the rock name given to the sample at the time that it was collected. The types of rocks included in each of the groups are summarized in the table labelled "Key to Lithology Group Symbols". On the map, circles representing rock samples with Pb content above the cutoff value are labelled with the letter indicating the lithology group for that sample.

In the Bradfield Canal quadrangle, most of the known prospects in which significant amounts of lead have been found, occur in the area near Texas Creek and the Salmon River, at the eastern corner of the quadrangle. In this area, lead usually occurs in galena and is commonly associated with other sulfides and sometimes with silver. Deposits are mainly within metamorphic rocks as quartz veins, with some disseminated deposits and sulfide lenses. Just west of the quadrangle, in the areas in and around Berg, Glacier, and Groundhog Basins, galena occurs with other sulfides and some silver and gold, as massive and disseminated deposits, and in quartz-carbonate veins. Mixed sulfides were found in skarn float in the Craig River area near the Canadian border, and must also be present in the Cone Mountain area to account for the high values in geochemical samples collected there.

The main concentration of atomic-absorption lead values from rock samples occurs in and around unit Tgr at Cone Mountain, southwest of boundary peak Mount Whipple. These samples are dominantly felsite dikes, with some samples of alkali-granite and other rocks. Scattered values above the cutoff level (mainly 25 to 40 ppm) occur elsewhere throughout the quadrangle, either singly or in small clusters. Most of these are from samples of metamorphic rocks.

Atomic-Absorption Lead Values At and Above 25 ppm Cutoff Level

Lithology	Samples	Percent	Geometric Mean	Range
Felsite	29	21	37 ppm	25 - 95 ppm
Alkali-granite	12	9	35	25 - 110
Granitic Rocks	12	9	31	25 - 40
Metamorphic Rocks	55	40	43	25 - 150
Veins	2	1	187	35 - 1000
Skarn	1	1	--	110
Other	27	20	29	25 - 50

Lead values from spectrographic analyses of rock samples show more scatter than the atomic-absorption values, with several diffuse or small clusters. Values of 70 to 150 ppm occur in and near unit Tgr at Cone Mountain; in felsite, alkali-granite, and other granitic rocks. Several small clusters of values occur in unit MzPzsp. A broad group of values in the eastern part of the quadrangle, mostly at 70 ppm, occurs in a portion of the leucocratic granodiorite of unit TKlg and in dikes of similar lithology within the neighboring TKgq unit. These values might represent Pb in silicates since they did not show up as high values among the atomic-absorption data. The highest spectrographic Pb values come from metamorphic and vein samples south of Gracey Creek Glacier and east of the Salmon River, in the southeastern corner of the quadrangle.

Spectrographic Lead Values At and Above 70 ppm Cutoff Level

Lithology	Samples	Percent	Geometric Mean	Range
Felsite	11	9.4	83 ppm	70 - 150 ppm
Alkali-granite	8	7	77	70 - 150
Granitic Rocks	65	56	76	70 - 200
Metamorphic Rocks	20	17	103	70 - 20000
Veins	9	8	4060	200 - >20000
Skarn	1	1	--	100
Other	3	2	70	70

Atomic-absorption Pb data from stream-sediment samples shows most of the highest values concentrated in and near unit Tgr near Cone Mountain. These include most of the samples in this area. A tail of samples extends south from Cone Mountain for several kilometers; possibly following unit TKlg. Three high values occur near Berg Mountain and a few are scattered sparsely elsewhere. The string of values from Blake Channel to Seward Passage is not supported by rock sample data, or by field observations of sulfide float or likely host-rock. These values are probably not an "analytical anomaly" however, because they were grouped in several analytical batches, they were not processed consecutively, and three of the values have corresponding high spectrographic values as well.

Position and clustering of high spectrographic Pb values for stream-sediment samples is generally in good agreement with that from atomic-absorption analyses. Two major clusters of high values occur, in and near Tgr and TKlg in the vicinity of Cone Mountain, and in the Texas Creek-Salmon River area. Five samples within unit MzPzsp near Berg Mountain also have high Pb values.

The highest five percent of Pb values from atomic-absorption analyses of heavy-mineral concentrate samples cluster on and north of unit Tgr near Cone Mountain. The upper seven percent of the spectrographic values cover this same area, with a few additional samples nearby in units Tgr, TKlg, and Tegq.

MAPS SHOWING DISTRIBUTION AND ABUNDANCE OF LEAD IN GEOCHEMICAL SAMPLES FROM THE BRADFIELD CANAL QUADRANGLE, SOUTHEASTERN ALASKA

by

R. D. KOCH AND R. L. ELLIOTT

1981