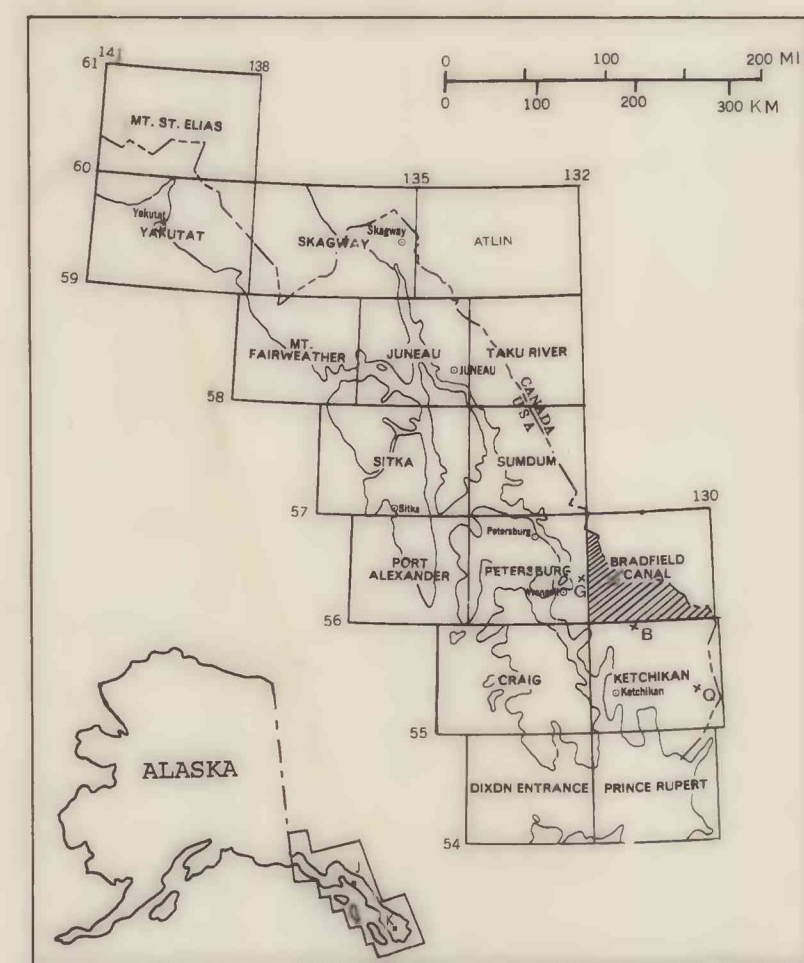
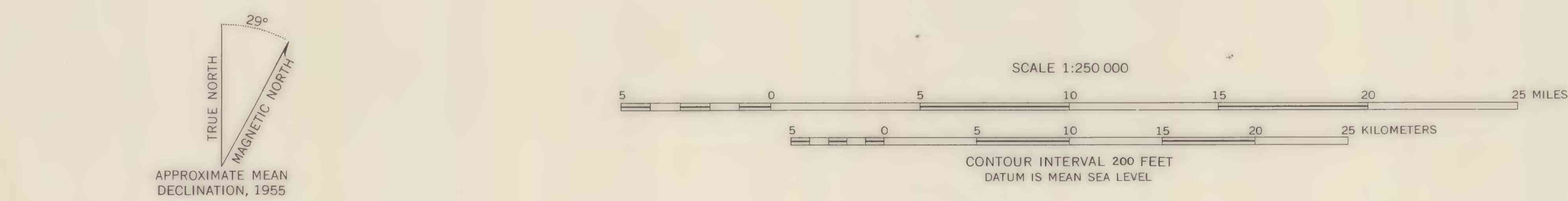




Base from USGS 1:250,000 topo series:  
Bradfield Canal, 1955, ALASKA-CANADA.

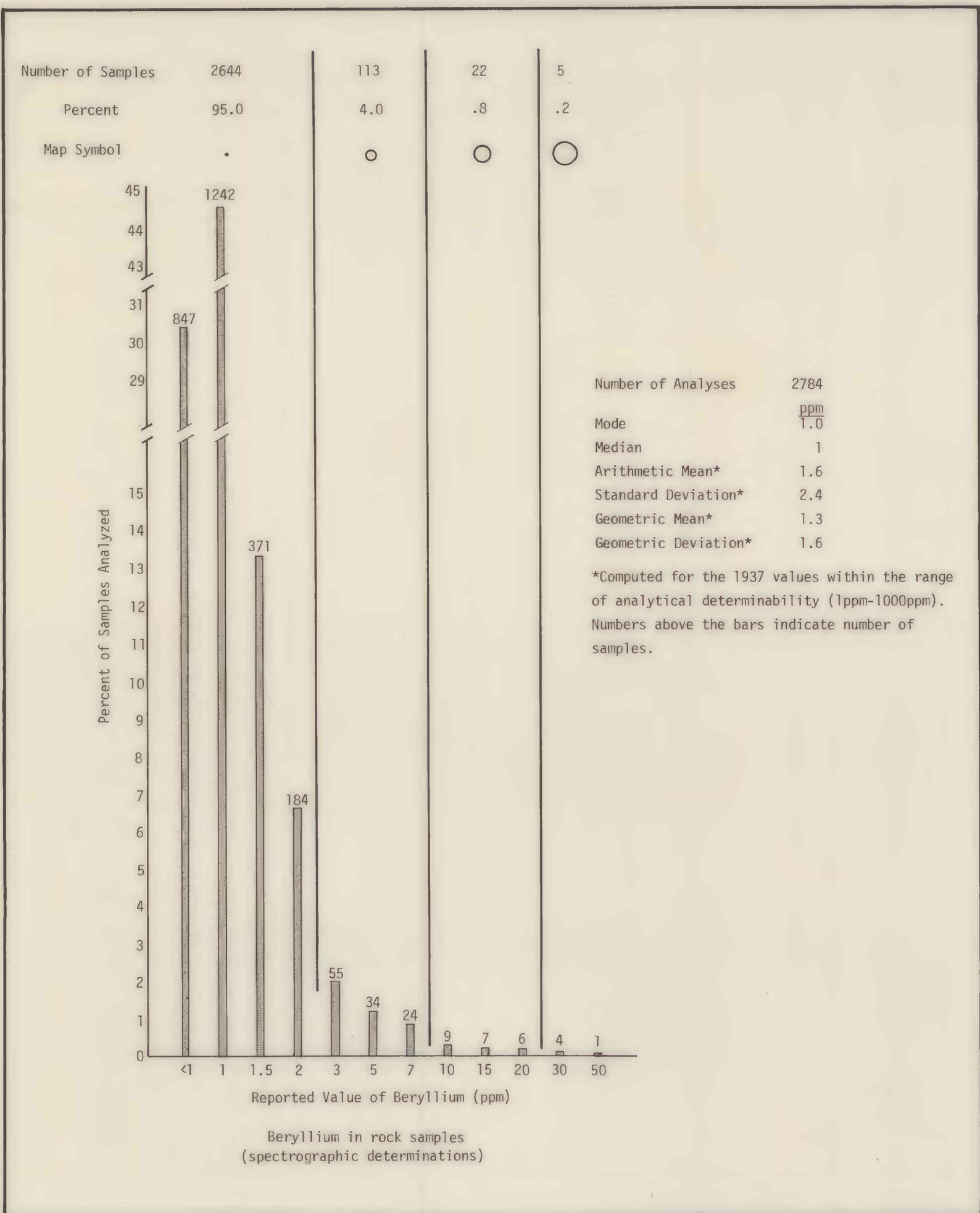
ROCK SAMPLES

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. Herdick, S. M. Karl, R. D. Koch,  
M. L. Miller-Hoare, R. P. Morrell, J. G. Smith, and  
R. A. Sonnevill, 1968-1979.



- KEY TO LITHOLOGY GROUP SYMBOLS
- A - ALKALI-FELDSPAR GRANITE - Includes related dikes
  - B - BASALT and ANDESITE - includes dikes and flows, and lamprophyre dikes
  - C - CALCISILICATE and SKARN
  - D - DIORITE and GABBRO - includes minor metadiorite, hornblende, 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 alkalic, apites, and pegmatite
  - H - HORNBLende-RICH SCHIST and GNEISS - includes amphibolite, greenschist, and other mafic metamorphic rocks
  - M - MUDWITTE and ORTHONEISS - includes granitic gneiss (eg: granodiorite gneiss, quartz diorite gneiss, etc.)
  - S - SCHIST and GNEISS - mainly pelitic and quartzfeldspathic schist and gneiss, and lesser non-schistose metasedimentary rocks
  - V - VEINS

- Unit Descriptions
- Qu UNCONSOLIDATED DEPOSITS, UNDIVIDED (Quaternary)
  - Qt 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)
  - Tegs GRANODIORITE AND QUARTZ DIORITE (Eocene)
  - Tq QUARTZ DIORITE (Eocene or Paleocene)
  - Tkg LEUCOCRATIC QUARTZ MONZONITE AND GRANODIORITE (Tertiary and/or Cretaceous)
  - TKgr GRANODIORITE AND QUARTZ DIORITE (Tertiary and/or Cretaceous)
  - Kgr BIOTITE-HORNBLende QUARTZ DIORITE, PLAGIOCLASE-PORPHYRITIC BIOTITE GRANODIORITE/QUARTZ DIORITE, BOTH LOCALLY CONTAIN GRABET AND/OR EPIDOTE (Cretaceous)
  - ht TEXAS CREEK GRANODIORITE (Triassic)
  - MpMg MIGMATITE AND ORTHONEISS, WITH LESSER PARAGNEISS (Mesozoic and/or Paleozoic)
  - MpPp PARAGNEISS AND ORTHONEISS, WITH LESSER AMPHIBOLITE AND MARBLE (Mesozoic and/or Paleozoic)
  - MpSg SCHIST AND PARAGNEISS, WITH LESSER AMPHIBOLITE AND MARBLE (Mesozoic and/or Paleozoic)
  - MpZv METASEDIMENTARY AND LESSER METAVOLCANIC ROCKS, WITH LOCAL MARBLE (Mesozoic and/or Paleozoic)



During U.S. Geological Survey investigations in the Bradfield Canal quadrangle between 1968 and 1979, 2784 rock geochemical samples, 1285 stream-sediment samples, and 210 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 sheet show the amounts of beryllium (Be) detected in all geochemical samples collected in the Bradfield Canal quadrangle. All beryllium analyses were by the 6-step spectrographic method. 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, ... (see Koch and others, 1980a,b,c, Grimes and Marranzino, 1968).

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 significant 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 Be content was at or 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 Be 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. Confidence levels are low for values near analytical limits of determinability 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 labeled "Key to Lithology Group Symbols". On the map, circles representing rock samples with Be content above the cutoff value are labeled with the letter indicating the lithology group for that sample.

There are no known concentrations of beryllium in the Bradfield Canal quadrangle which have potential economic value because of their Be content. Most beryllium in the Earth's crust occurs in low concentrations in common rock-forming silicates, where it commonly replaces silicon. It becomes progressively more concentrated in magma during crystallization, and its concentration tends to increase in parallel with that of silica and alkalis (Griffiths, 1973).

Small, mid-Tertiary, felsic stocks occur in a number of places in and near the Coast Plutonic Complex in the vicinity of the Bradfield Canal quadrangle. Several of these stocks, and many quartz-porphyritic felsite dikes associated with them, have unusually high concentrations of a number of metallic elements, notably molybdenum. Two of these stocks (located at points "a" and "b" on the index map) are low-grade stockwork molybdenite deposits (Hudson, Smith, and Elliott, 1979). Beryllium in these felsic rocks is concentrated to levels noticeably above the levels in normal granitic rocks of the Coast Range. It is concentrated throughout these rocks, not just in the mineralized portions. High levels of Be usually show up in more samples than do high values of potentially economic commodities. Thus Be may provide a better indicator for locating lithologies which are favorable potential hosts for valuable mineral deposits.

Beryllium concentrations in most of the samples analyzed are in a relatively restricted range near the lower limit of analytical determinability (1 ppm for rock and stream-sediment samples, 2 ppm for concentrate samples). For this reason, analytical precision of the 6-step spectrographic method (Motoko and Grimes, 1976) somewhat limits the interpretation of Be values near the cutoff level of 3 ppm. Samples or areas where values range no higher than 3 to 5 ppm probably represent the high end of normal background levels and not the presence of the highly differentiated rocks. In spite of this limitation, locations of samples with relatively high Be values correlate very well with locations of known highly differentiated stocks and related felsite dikes. It is unlikely that many highly differentiated rocks have marginal levels of Be and are lost in the background just below the cutoff level. No known bodies of this type have failed to stand out and the other Be values from the Ketchikan and Bradfield Canal quadrangles (Koch and Elliott, 1979a,b,c).

In the Bradfield Canal quadrangle, the majority of rock samples with Be concentrations at and above the 3 ppm cutoff level, and all samples with Be values of 10 ppm or more, are from two lithologies: the alkali-granite at Cone Mountain, southwest of boundary peak Mount Whipple, and felsite dikes in the area near Cone Mountain. Values below 10 ppm occur in other granitic rocks and in some metamorphic rocks scattered sparsely across the quadrangle.

| Rock Sample Beryllium Values At and Above 3 ppm |        |         |                |            |
|---|--------|---------|----------------|------------|
| Lithology                                       | Sample | Percent | Geometric Mean | Range      |
| Alkali-granite                                  | 45     | 31      | 6              | 3 - 50 ppm |
| Felsite   | 43     | 31      | 3              | 3 - 5      |
| Granitic Rocks                                  | 22     | 16      | 3              | 3 - 5      |
| Metamorphic Rock                                | 20     | 14      | 2              | 2 - 3      |
| Skarn   | 4      | 3       | 4.2            | 3 - 7      |
| Other   | 6      | 4       | 4.4            | 3 - 7      |

The only significant cluster of stream-sediment and heavy-mineral concentrate samples with Be values at and above the 3 ppm cutoff level is in and around the alkali-granite at Cone Mountain. Only nine stream-sediment samples, and no concentrate samples with Be values above the cutoff level occur elsewhere in the quadrangle.

| Average abundance* of beryllium (in ppm) in the Earth's crust and various crustal components. (From Levinson, 1974) |             |        |         |       |           |      |   |
|---|-------------|--------|---------|-------|-----------|------|---|
| Earth's crust   | Ultra-mafic | Basalt | Granite | Shale | Limestone | Soil |   |
| Be  | 2.8         | -      | 0.5     | 2     | 5         | 3    | 1 |

\*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., Pittman, T. L., and Kimball, A. L., 1977, Mineral resources of the Granite Folds wilderness study area, Alaska: U.S. Geological Survey Bulletin 1403, 151 p.
- Griffiths, W. R., 1973, Beryllium, in Brobst, D. A. and Pratt, W. P., ed., United States mineral resources: U.S. Geological Survey Professional Paper 820, p. 85-93.
- Grimes, D. J., and Marranzino, A. P., 1968, Direct-current arc and alternating-current spark emission spectrographic field methods for the semi-quantitative analysis of geologic materials: U.S. Geological Survey Circular 591, 6 p.
- Hudson, Travis, Smith, J. G., and Elliott, R. L., 1979, Petrology, composition, and age of intrusive rocks associated with the Quartz Hill Molybdenum Deposit, southeastern Alaska: Canadian Journal of Earth Sciences, v. 16, p. 1805-1822.
- Koch, R. D., and Elliott, R. L., 1978a, Analyses of rock samples from the Ketchikan quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 78-156A, 163 p.
- , 1978b, Analyses of rock and stream-sediment samples from the Price Rupert quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 78-156B, 98 p.
- , 1978c, Analyses of stream-sediment samples from the Ketchikan quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 78-156C, 214 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, 285 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 US85-60-004 or NTIS-P881-108641.
- Levinson, A. A., 1974, Introduction to exploration geochemistry: Wilmette, Illinois, Allied Publishing Ltd., 614 p.
- Motoko, J. M., and Grimes, D. J., 1976, Analytical precision of the one-sixth order semi-quantitative 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, 40 p.
- Ward, F. N., Nakagawa, H. M., Harms, T. F., and Van Stickle, G. W., 1969, Atomic-absorption methods of analysis useful in geochemical exploration: U.S. Geological Survey Bulletin 1289, 46 p.

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

by

R. D. KOCH AND R. L. ELLIOTT