UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PETROGRAPHIC AND CHEMICAL DATA ON CRETACEOUS GRANITIC
ROCKS OF THE BIG DELTA QUADRANGLE, ALASKA

By
Stephen T. Luthy, Helen L. Foster, and Grant W. Cushing

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Petrographic and chemical data on Cretaceous granitic rocks
of the Big Delta Quadrangle, Alaska

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Introduction

This report presents petrographic and chemical data on granitic rocks of known Cretaceous age and a few of probable Cretaceous age in the Big Delta Quadrangle (plate 1). The Big Delta Quadrangle is located in the central part of the Yukon-Tanana Upland in east-central Alaska. The Yukon-Tanana Upland is a maturely dissected terrane primarily composed of metamorphic and igneous rocks (Mertie, 1937; Weber and others, 1978). Plutons of Cretaceous and Tertiary age, which range from diorite to granite in composition, intrude metamorphic rocks having both igneous and sedimentary protoliths. The age of the protoliths are unknown but include Paleozoic and possibly Precambrian rocks. Metamorphic grade ranges from greenschist to amphibolite facies. The time or times of major regional metamorphism are not yet determined but were previous to intrusion of the Mesozoic granitic rocks. The most abundant metamorphic rock types are quartzite, quartz-biotite schist and gneiss, marble, amphibole schist, amphibole gneiss, and greenschist.

Unmetamorphosed granitic plutons of the Big Delta Quadrangle are considered to be of Cretaceous and Tertiary ages on the basis of K/Ar age determinations. Plutons of Triassic or Jurassic age have not been found in the Big Delta Quadrangle, although they occur to the east in the Eagle Quadrangle. In this paper only the plutons of granitic composition with Cretaceous K/Ar ages and a few plutons of probable Cretaceous age that have not yet been radiometrically dated are described.
Field data were collected mostly during the course of reconnaissance geologic mapping and geochemical sampling in the Big Delta Quadrangle for the Alaskan Mineral Resource Assessment Program from 1974 to 1977 (Foster and others, 1979). Most of the potassium-argon ages were determined by F. H. Wilson, but J. G. Smith and D. L. Turner also provided some radiometric age data (Foster and others, 1979).

The data presented in this paper are intended to supplement and to be used in conjunction with data on Mesozoic granitic rocks of the adjacent Eagle Quadrangle (Foster, Donato, and Yount, 1978). The largest granitic plutons of the Yukon-Tanana Upland are in the western and northern parts of the Eagle Quadrangle, and parts of these plutons probably extend westward into the Big Delta Quadrangle.

These data should help provide a basis for comparison of the Mesozoic granitic plutons of the Yukon-Tanana Upland with those elsewhere in Alaska and in Canada. Comparison of plutons on both sides of the Shaw Creek fault (Hudson and others, 1976; fig. 1) may aid in determining the time and sense of displacement along this major northeast-trending structure. Interpretation of the data is not included in this report.

Type and method of data presentation

Petrographic and chemical data are presented in three tables and one map. Petrographic data, radiometric ages, and modal analyses obtained by point counts on stained slabs and stained thin sections are given in table 1, whole-rock major-element chemical analyses for four samples are given in table 2, and semiquantitative spectrographic analyses for 70 samples (Foster, O'Leary, and others, 1978) are given in table 3. Localities for all thin sections and analyzed samples are shown on the map (plate 1).
The granitic rock samples were collected from 12 different plutons (plate 1). The plutons are differentiated primarily on the basis of map distribution. Because the plutons are not mapped in detail, some which appear spatially distinct may in fact be genetically related. Other plutons which are represented as single bodies may be composite.

A few plutons of uncertain age are included because they appear closely related to dated Cretaceous plutons, including some in the adjacent Eagle Quadrangle, and because knowledge of their petrography may be useful in future studies of the Shaw Creek fault (Hudson and others, 1976).

Nomenclatures and classification of the granitic rocks follows that of the I.U.G.S. Subcommission on the Systematics of Igneous Rocks (Streckeissens, 1973).

Chemical data

Three whole-rock major-element chemical analyses were made by the X-ray fluorescence method described by Fabbi and Elsheimer (1976). Analysis by the rapid rock method (Shapiro, 1967; Shapiro and Brannock, 1967) was done on a fourth sample.

CIPW norms (table 2) were calculated using the Nevada Bureau of Mines and Geology computer program "Petcal". The calculations are explained in the program description (Bingler and others, 1976).

Samples for semiquantitative spectrographic analysis (table 3) were collected as single grab samples as part of a reconnaissance geochemical sampling program for the Big Delta Quadrangle (Foster, O'Leary, and others, 1978). Most of the granitic rocks were obtained for background information. Analysis using a six-step semiquantitative method described by Grimes and Marranzino (1968) are reported for 26 elements. An atomic absorption spectrophotometric method described by Ward and others (1969) was used to more
accurately determine the abundance of gold. For the semiquantitative spectrographic analyses, iron, magnesium, calcium, and titanium values are reported in percent and values for other elements are reported in parts per million (ppm). Results are given as the approximate midpoints of geometric brackets whose boundaries are 1.2, 0.83, 0.56, 0.38, 0.26, 0.18, 0.12, etc. These midpoints are 1, 0.7, 0.5, 0.3, 0.2, 0.15, 0.1, etc. The precision of a reported value is approximately plus or minus one reporting value at 68 percent confidence or two reporting values at 99 percent confidence. Samples collected in 1975 and 1977 were analyzed in the laboratories of the Branch of Exploration Research, U.S. Geological Survey, and the approximate visual lower limits of determination for the analyses are as follows:

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</tr>
<tr>
<td>Mg</td>
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</tr>
<tr>
<td>Ca</td>
<td>0.05 percent</td>
</tr>
<tr>
<td>Ti</td>
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</tr>
<tr>
<td>Mn</td>
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<tr>
<td>Ag</td>
<td>0.5 ppm</td>
</tr>
<tr>
<td>As</td>
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</tr>
<tr>
<td>B</td>
<td>10 ppm</td>
</tr>
<tr>
<td>La</td>
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<tr>
<td>Sn</td>
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<td>10 ppm</td>
</tr>
<tr>
<td>Co</td>
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</tr>
<tr>
<td>Pb</td>
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</tr>
<tr>
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<tr>
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<td>5 ppm</td>
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<tr>
<td>Zr</td>
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Some samples collected in 1974 were analyzed by the Branch of Analytical Laboratories, U.S. Geological Survey. For these samples, the approximate visual lower limits of determination are slightly lower than those used by the Branch of Exploration Research for the following elements reported in parts per million: barium, 10; cobalt, 3; chromium, 1; molybdenum, 3; niobium, 7; lead, 7; tin, 5; and strontium, 5.
References cited


Table 1
See attached 2 sheets
Table 2: Major element chemical analyses in weight percent and CIPW normative minerals for four Cretaceous granitic rocks of the Big Delta Quadrangle, Alaska.

[Analysts: L. Espos and H. Smith. *, indicates rapid rock analyses, method described by Shapiro and Brannock (1967). Other analyses are by X-ray fluorescence, method described by Fabbi and Elsheimer (1976). ---, indicates sample not analyzed for element oxide or normative mineral concentration.]

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Table 3.--Semiquantitative spectrographic analyses for Cretaceous granitic rocks of the Big Delta Quadrangle, Alaska.

[Analysts: J. E. Abrams, N. M. Conklin, E. F. Cooley, G. L. Crenshaw, J. A. Criswell, G. W. Day, R. A. Havens, R. C. Karlson, J. W. McNamara, and R. M. O'Leary. S before an element indicates analysis by emission spectrography. AA indicates analysis by atomic absorption. Analysis given in parts per million (ppm) for all elements except Fe, Mg, Ca, and Ti which are given in percent. Zeros to right of decimal point may or may not be significant. N, element not detected; ---, sample was not analyzed for element; <, element detected in amount less than detection limit of determination.]

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...
Table 3.--Semiquantitative spectrographic analyses for Cretaceous granitic rocks of the Big Delta Quadrangle, Alaska--Continued.

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Table 3.—Semiquantitative spectrographic analyses for Cretaceous granitic rocks of the Big Delta Quadrangle, Alaska—Continued.

| FIELD NUMBER | PLUTON NUMBER | QUAD | S-FE % | S-MG % | S-Ca % | S-Ti % | S-MN ppm | S-AG ppm | S-AS ppm | S-B ppm | S-BA ppm | S-BE ppm | S-BI ppm | S-CO ppm | S-SC ppm | S-CU ppm |
|--------------|---------------|------|--------|--------|--------|--------|----------|----------|----------|---------|----------|----------|----------|----------|----------|
| 7SAF 2158    | 7             | C-2  | ______ | ______ | ______ | ______ | N        | N        | 20       | 700     | 30       | N        | 10       | 10       | <5       |
| 7SAF 2307    | 7             | C-2  | ______ | ______ | ______ | ______ | N        | N        | 20       | 500     | 20       | N        | 5        | 10       | 30       |
| 7SAF 2214    | 7             | C-2  | ______ | ______ | ______ | ______ | N        | N        | <10      | 700     | 10       | N        | 10       | 10       | 15       |
| 7SAF 2220    | 7             | C-2  | ______ | ______ | ______ | ______ | N        | N        | <10      | 1000    | 10       | N        | 15       | 20       | 10       |
| 7SAF 2368    | 8             | C-2  | ______ | ______ | ______ | ______ | N        | N        | <10      | 1000    | 10       | N        | 10       | 10       | 5        |
| 7SAF 3144    | 8             | C-2  | ______ | ______ | ______ | ______ | N        | N        | <10      | 700     | 10       | N        | N        | <5       | <5       |
| 7SAF 171     | 9             | B-4  | 2.00   | 15     | <0.5   | 300     | 50       | N        | <200     | 50      | 200      | 20       | N        | <5       | 20       | 50       |
| 7SAF 2288    | 9             | B-4  | 1.00   | 10     | 50     | 1000     | 20       | N        | 15      | 500     | 10       | <5       | N        | <5       | N        |
| 7SAF 2244    | 9             | B-4  | 1.00   | 10     | 50     | 1000     | 30       | N        | N        | 700     | <5       | N        | N        | <5       | <5       |
| 7SAF 586     | 10            | B-1  | 1.50   | 300    | 700    | 100      | 300      | N        | N        | 700     | <5       | N        | 10       | N        |
| 7SAF 589     | 10            | B-1  | 1.50   | 300    | 700    | 100      | 300      | N        | N        | 1500    | <5       | N        | 10       | N        |
| 7SAF 592     | 10            | B-1  | 1.50   | 300    | 700    | 100      | 300      | N        | N        | 700     | <5       | N        | 3        | 10       | 7        |
| 7SAF 595     | 10            | B-1  | 1.50   | 300    | 700    | 100      | 300      | N        | N        | 700     | <5       | N        | 3        | 10       | 7        |
| 7SAF 594     | 10            | B-1  | 1.50   | 300    | 700    | 100      | 300      | N        | N        | 700     | <5       | N        | 3        | 10       | 7        |
| 7SAF 636     | 10            | B-1  | 2.00   | 700    | 2000   | 150      | 300      | N        | N        | 1500    | <5       | N        | 3        | 10       | 5        |
| 7SAF 638     | 10            | B-1  | 2.00   | 700    | 2000   | 150      | 300      | N        | N        | 700     | <5       | N        | 5        | 10       | 5        |
| 7SAF 640     | 10            | B-1  | 3.00   | 700    | 2000   | 150      | 300      | N        | N        | 1000    | <5       | N        | 3        | 10       | 10       |
| 7SAF 641     | 10            | B-1  | 1.50   | 300    | 700    | 150      | 300      | N        | N        | 700     | <5       | N        | 3        | 10       | 10       |
| 7SAF 645     | 10            | B-1  | 2.00   | 700    | 3000   | 150      | 700      | N        | N        | 1000    | <5       | N        | 5        | 20       | 10       |
| 7SAF 647     | 10            | B-1  | 3.00   | 700    | 3000   | 150      | 700      | N        | N        | 1000    | <5       | N        | 7        | 30       | 70       |
| 7SAF 657     | 10            | B-1  | 3.00   | 700    | 3000   | 150      | 700      | N        | N        | 1500    | <5       | N        | 7        | 30       | 70       |
| 7SAF 665     | 10            | B-1  | 1.60   | 200    | 1200   | 100      | 300      | N        | N        | 1500    | 30       | 10       | 10       | 10       | 10       |
| 7SAF 704     | 11            | C-1  | 3.00   | 100    | 1000   | 150      | 300      | N        | N        | 100     | 10       | N        | N        | N        |
| 7SAF 785     | 11            | C-1  | ______ | ______ | ______ | ______ | N        | N        | 700     | 200     | N        | 10       | N        | <5       |
| 7SAF 4011A   | 11            | C-1  | ______ | ______ | ______ | ______ | N        | N        | 30      | 300     | 70       | 15       | N        | 10       | <5       |
| 7SAF 4042    | 11            | D-1  | ______ | ______ | ______ | ______ | N        | N        | 150     | 1000    | 30       | N        | 5        | 10       | 15       |
| 7SAF 4074    | 11            | D-1  | ______ | ______ | ______ | ______ | N        | N        | 10      | 1000    | 10       | N        | 5        | 10       | 30       |
Table 3.—Semiquantitative spectrographic analyses for Cretaceous granitic rocks of the Big Delta Quadrangle, Alaska—Continued.

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