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PRELIMINARY GEOLOGIC MAP OF TYONEK D-6 AND EASTERN TYONEK D-7 QUADRANGLES, ALASKA

by

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Introduction

The Tyonek D-6 and D-7 quadrangles are located in the southern Alaska Range, about 130 km west of Anchorage. The map area is drained by the Skwentna, Hayes and Trimble Rivers, and varies in elevation from under 500 feet to over 5500 feet. Geologic mapping for this report was done between July 21 and August 2, 1990 as part of the Alaska Division of Geological and Geophysical Surveys (ADGGS) southern Alaska 1:63,360 mapping project. Field observations were recorded at 1:40,000 scale, and are presented here at that scale. Results of geochemical analysis of rocks and pan concentrates have been previously released as ADGGS Public Data File 91-1 (Solie and others, 1991).

Previous mapping in the area, published at 1:250,000 scale or smaller (Barnes, 1966; Magoon and others, 1976; Manning and Hinderman, 1982), has been reconnaissance in nature, with major rock units outlined but undifferentiated. The mapping of Reed and others (Reed and Nelson, 1980; Reed and Elliott, 1970) covers areas just north and west of this study area.

Geology

The bedrock geology of the map area consists of small isolated exposures of coal-bearing Tertiary Kenai Group sedimentary rocks, which lay unconformably on Jurassic to Cretaceous sedimentary rocks. The latter are generally considered to be turbidites of the Kahiltna terrane (eg, Jones and others, 1987). Mafic volcanic rocks of uncertain age are juxtaposed either structurally or depositionally against the Juro-Cretaceous sedimentary rocks. We interpret these as possible correlatives of the Talkeetna Formation, mapped to the south (eg, Detterman and Hartsock, 1966) and east (eg, Grantz, 1960; Burns and others, 1991). Plutonic and hypabyssal rocks, mafic to felsic, intrude the Juro-Cretaceous rocks. The igneous rocks are considered to include Cretaceous and Tertiary ages of crystallization, based on regional plutonic history (eg, Reed and Lanphere, 1972).

A veneer of volcanic ash from the 1989-1990 eruptions of Mount Redoubt, located about 150 km to the south, covered much of the map area. An older generation of volcanic debris, with pumice fragments up to about 5 cm diameter, is probably from Mount Spurr, located about 65 km south of the map area.

The structural history of the map area is complex, as evidenced by the lack of consistent bedding attitudes or rock types over any appreciable distance. Isoclinal and open folds are evident at outcrop to ridgelength scale in the Juro-Cretaceous section. Larger scale folds generally tend to plunge eastward. Sedimentary structures reveal that beds are commonly overturned. The outcrop map pattern in southwestern D-6 quadrangle (Plate 1) is largely schematic, based on observed fold patterns and rock variations.

The true map pattern would undoubtedly be more complex than shown. Small-scale faults are common in the map area, but are not indicated on the map due to lack of traceability and probable small amounts of movement along them. Extensive shearing in the bluffs along the Skwentna River indicates a zone of major deformation, however, the orientation and direction of movement on the fault are not yet known.

Small porphyritic intermediate plugs, dikes and sills with feldspar and/or hornblende phenocrysts are numerous in the map area, though commonly too small to be shown on the map. Adjacent sedimentary rocks are typically affected by contact metamorphism resulting in hornfels aureoles up to several meters wide.

Whole Rock Analyses

Results of major oxide and selected trace element analyses of representative igneous rocks from the study area are reported in Tables 1 and 2. Locations of samples in Tyonek D-6 and D-7 are shown on Plate 1; sample locations in Tyonek C-6 are shown on Figure 1, and also on Plate 1 of Solie and others (1991). Brief sample descriptions are given in Table 3. Intrusive rock names follow the classification scheme of Streckeisen (1976). CIPW norms (Tables 1 and 2) are calculated using oxides normalized on an anhydrous basis.

The samples in Table 1 were analyzed at Washington State University. Based on a set of four duplicate pairs, precision of results from this laboratory for the major elements is $<1\%$ relative to totals except for Fe and Mg, which are 1% and 2% respectively and 0.05 weight percent absolute. Precision for reported trace elements is a few ppm absolute or 5% relative. Duplicates were not run for the samples in Table 2, which were analyzed by X-Ray Assay Laboratories. Reported detection limits for these analyses are 0.01 weight percent for major oxides, except FeO which is 0.1 weight percent. Reported detection limit for trace elements is 10 ppm.

Discriminant scores reported in Table 2 reflect the similarity in composition between the analyzed intrusive rocks in the study area and intrusive rocks associated worldwide with gold. The scores were derived from a discriminant function, described in Burns and others (1991), which is applicable only to silica-saturated intrusive rocks, (but not aplites), which have not been altered, and which are not part of a porphyry copper system. A discriminant score of 0.0 indicates no favorability for associated non-porphyry gold; 100.0 indicates an excellent probability for associated non-porphyry gold. The discriminant function is highly dependent on FeO/Fe_2O_3, therefore scores are not given for the data in Table 1 where total iron is reported as FeO. Of the applicable rock types in Table 1, there is a high favorability for associated gold with most of the samples, particularly those samples with scores over 95.0. These include rocks from the Kichatna pluton in the northwest corner of Tyonek D-6, several mafic plugs and dikes, and intermediate small fine-grained intrusive bodies in the Tyonek D-6 and D-7 quadrangles. Scores above 70.0 represent moderate potential for gold association, as in the diorite body west of Dickason Mountain, and some intrusives from the Tyonek C-6 quadrangle. The favorability of many intrusive compositions for association with gold in the study area, and the presence of visible gold in six of fifteen pan concentrate samples (Solie and others, 1991) indicates good gold potential in the region and warrants further investigation in order to evaluate economic potential.

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References Cited

Barnes, F.F., 1966, Geology and coal resources of the Beluga-Yentna region, Alaska: U.S.G.S. Bulletin 1202-C, p.C1-C54, 7 pl.

Burns, L.E., Newberry, R.J. and Solie, D.N., 1991, Quartz normative plutonic rocks of interior Alaska and their favorability for association with gold; Alaska Division of Geological and Geophysical Surveys Report of Investigations, in review.

Burns, L.E., Pessel, G.H., Little, T.A., Pavlis, T.L., Newberry, R.J., Winkler, G.R. and Decker, J.E., 1991, Geology of the northcentral Chugach Mountains, Alaska: Alaska Division of Geological and Geophysical Surveys Professional Report 90, in press.

Detterman, R.L. and Hartsock, J.K., 1966, Geology of the Iniskin - Tuxedni region, Alaska: U.S. Geological Survey Professional Paper 512, 78 p., 6 pl.

Grantz, Arthur, 1960, Geologic map of the Talkeetna Mountains A-2 quadrangle, Alaska, and the contiguous area to the north and northwest: U.S.G.S. Map I-314.

Jones, D.L., Silberling, N.J., Coney, P.J. and Plafker, G., 1987, Lithotectonic terrane map of Alaska (west of the 141st meridian): USGS Map MF-1874-A, scale 1:250,000.

Magoon, L.B., Adkinson, W.L. and Egbert, R.M., 1976, Map showing geology, wildcat wells, Tertiary plant fossil localities, K-Ar age dates, and petroleum operations, Cook Inlet area, Alaska: U.S. Geological Survey Map I-1019, 3 sheets, scale 1:250,000.

Manning, K.H. and Hinderman, T.K., 1982, National uranium resource evaluation, Tyonek quadrangle, Alaska: C.C. Hawley and Associates, Inc., prepared for U.S. Department of Energy, report PGJ/F-059(82), 17p., 14pl.

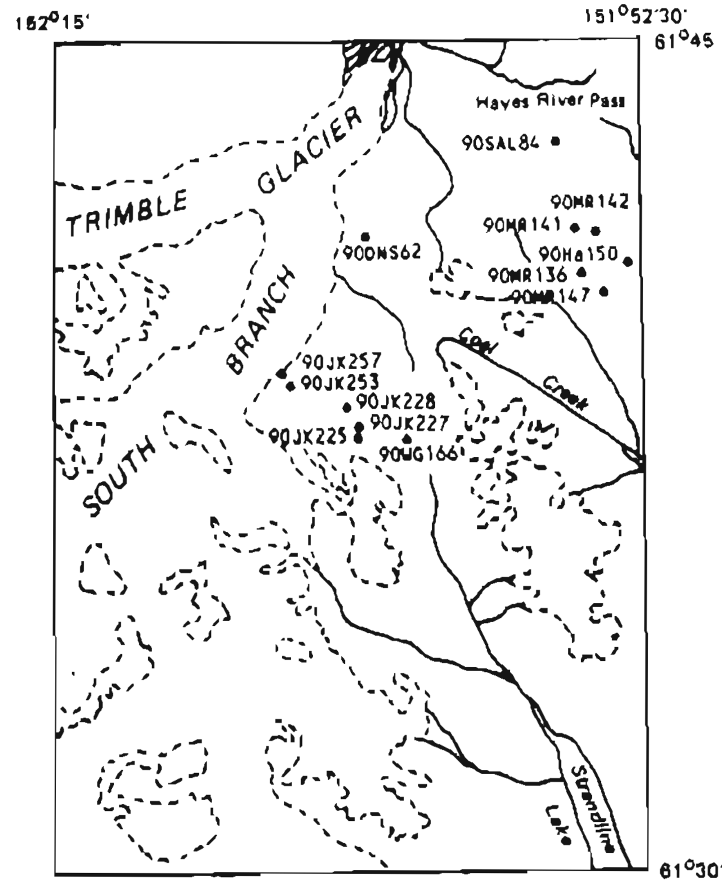
Reed, B.L. and Elliott, R.L., 1970, Reconnaissance geologic map, analysis of bedrock and stream-sediment samples, and an aero-magnetic map of parts of the southern Alaska Range: U.S. Geological Survey open-file report 413 (70-271), 158 p., scale 1:250,000.

Reed, B.L. and Lanphere, M.A., 1972, Generalized geologic map of the Alaska-Aleutian Range batholith showing potassium-argon agees of the plutonic rocks: U.S. Geological Survey Map MF-372, 2 pl., scale 1:1,000,000.

Reed, B.L. and Nelson, S.W., 1980, Geologic map of the Talkeetna quadrangle, Alaska: U.S. Geological Survey Map I-1174, 1 pl., scale 1:250,000.

Solie, D.N., Kline, J.T., Gilbert, W.G., Robinson, M.S., Harris, E.E. and Liss, S.A., 1991, Analytical results from rock and pan concentrate samples, Tyonek D-6 and parts of adjacent quadrangles, Alaska: Alaska Division of Geological and Geophysical Surveys Public Data File 91-1, 13 p., 1 pl.

Streckeisen, A., 1976, To each plutonic rock its proper name: Earth Science Review, v.12, p.1-33.



Base adapted from USGS 1:250 000 scale Tyonek Quadrangle Alaska, 1958.

Scale 1:250,000

• Major oxide sample site (1990)

Figure 1. Location map of major oxide samples from the Tyonek C-8 quadrangle, Alaska.

Table 1. Major oxide and trace element analyses and CIPW norms, Tyonek D-6, D-7 and C-6 quadrangles.

Map No.	12	13	19	11	10	-	-	17	-
Sample	90DNS07	90DNS08	90DNS17	90DNS31	90DNS36	90DNS62	90HA150	90JK175	90JK227
Quad	D-6	D-6	D-5	D-6	D-6	C-6	C-6	D-6	C-6
				MAJOR OXIDES (weight percent)					
SiO2	56.76	56.27	74.93	60.78	59.79	72.83	72.80	76.68	63.50
Al2O3	17.91	17.52	13.61	17.79	16.60	14.74	14.46	13.21	16.36
CaO	6.65	6.85	0.59	5.08	5.54	1.65	1.26	0.13	4.68
MgO	3.04	4.04	0.05	1.88	3.40	0.22	0.34	0.00	2.40
Na2O	3.87	3.61	4.91	4.15	5.26	4.63	4.51	4.60	4.15
K2O	2.65	2.74	4.34	3.50	2.32	3.75	4.39	4.35	3.41
FeO*	7.35	7.36	1.39	5.46	5.75	1.84	1.95	0.90	4.59
MnO	0.116	0.134	0.045	0.111	0.118	0.059	0.052	0.010	0.111
TiO2	1.272	1.141	0.123	0.965	0.956	0.229	0.194	0.099	0.551
P2O5	0.386	0.337	0.018	0.287	0.290	0.058	0.056	0.010	0.243
Sum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
				TRACE ELEMENTS (ppm)					
Cr	32	64	0	13	25	0	1	0	34
Rb	86	92	109	98	36	96	122	102	81
Sr	572	566	52	508	1159	198	139	16	716
Y	26	24	37	27	22	20	33	35	17
Zr	171	210	177	227	208	148	163	208	134
Nb	16.8	12.6	16.9	17.2	21.0	11.8	15.0	21.5	8.8
Ba	1003	992	1363	1181	1042	876	918	1034	896
Pb	14	14	14	13	4	16	16	9	17
Th	8	7	8	12	5	10	8	7	0
Ga	21	20	18	20	19	17	19	22	18
Cu	21	27	4	11	0	0	3	4	65
Zn	93	92	73	79	46	42	52	38	80
V	144	168	2	77	145	9	6	0	110
Sc	23	23	1	17	17	5	2	4	12
Ni	10	15	9	9	13	8	8	10	19
				CIPW NORMS (weight percent)					
Qtz	5.71	4.39	28.08	9.63	4.85	27.23	26.04	32.73	13.10
Cor	0.00	0.00	0.00	0.00	0.00	0.21	0.14	0.72	0.00
Or	15.62	16.15	25.63	20.64	13.67	22.14	25.92	25.70	20.12
Ab	32.65	30.46	41.52	35.04	44.39	39.14	38.13	38.91	35.05
An	23.60	23.45	2.28	19.53	14.79	7.79	5.85	0.58	15.91
Di	5.53	6.68	0.45	3.05	8.65	0.00	0.00	0.00	4.63
Hy	9.58	12.11	0.98	6.54	7.91	1.88	2.32	0.64	7.01
Mt	4.01	3.82	0.79	3.08	3.24	1.04	1.10	0.51	2.59
Ilm	2.41	2.16	0.23	1.83	1.82	0.44	0.36	0.19	1.04
Ap	0.89	0.79	0.05	0.67	0.67	0.14	0.14	0.02	0.56
Sum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Analyses by D.Johnson, Washington State University. - = Location shown on Figure 1. Feo* = Total Fe as FeO.

Table 1. Major oxide and trace element analyses and CIPW norms, Tyonek D-6, D-7 and C-6 quadrangles.

Map No.	-	16	-	-	8	8	-	25	23
Sample	90JK228	90MR114C	90MR136C	90MR147C	90SAL44A	90SAL44B	90SAL84A	90WG119	90WG121
Quad	C-6	D-6	C-6	C-6	D-7	D-7	C-6	D-6	D-6
MAJOR OXIDES (weight percent)									
SiO2	72.51	59.09	72.12	68 27	68.36	64.85	58.02	65.47	67.09
Al2O3	14.82	17.83	14.56	15.73	15.81	16.95	17.73	16.56	16.10
CaO	1.49	5.19	1.57	2.65	2.37	2.48	6.09	3.85	2.47
MgO	0.27	2.26	0.25	0.81	0.58	0.99	3.22	0.94	0 02
Na2O	4.58	3.92	4.62	4 64	4.32	4.32	4.03	4.00	5.81
K2O	3.89	4.03	4.10	3.53	4.09	4.39	2.09	3.41	2.91
FeO*	2.08	6.23	2.40	3.69	3.81	5.19	7.37	4.78	4 96
MnO	0.061	0.108	0.065	0.092	0.078	0.069	0.145	0.110	0.162
TiO2	0.236	1.042	0.245	0.441	0.434	0.536	0.994	0.652	0.423
P2O5	0.065	0.293	0.068	0.142	0.139	0.229	0.299	0.213	0.051
Sum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
TRACE ELEMENTS (ppm)									
Cr	0	21	0	0	4	0	18	1	0
Rb	86	119	112	92	132	175	61	72	60
Sr	195	478	186	306	322	454	552	463	295
Y	18	28	33	25	22	22	23	28	34
Zr	168	321	202	212	219	210	175	202	248
Nb	12.0	16.3	13.5	13.7	13.9	18.5	13.6	10.5	15.9
Ba	949	1446	1013	1220	863	1198	814	1305	1750
Pb	17	12	16	12	18	18	8	13	11
Th	7	11	8	6	9	10	3	7	3
Ga	18	19	20	21	20	24	17	21	25
Cu	7	13	1	0	9	147	9	2	0
Zn	47	77	62	70	58	65	97	81	134
V	7	114	15	48	22	30	138	58	5
Sc	4	17	4	10	7	9	19	15	22
Ni	9	10	7	6	6	6	8	6	4
CIPW NORMS (weight percent)									
Qtz	26.86	6.42	25 27	20 17	20.75	15 04	7.73	18.69	15 73
Cor	0.52	0.00	0.00	0.00	0.30	1.13	0.00	0.00	0 00
Or	22.97	23.76	24.20	20.83	24 13	25.89	12.32	20.12	17 16
Ab	38.72	33.09	39 05	39.21	36.50	36.47	34.02	33.79	49.07
An	6.96	19.11	6 88	11 65	10 83	10.78	24.06	17.13	9.24
Di	0.00	3.84	0 39	0.47	0.00	0.00	3.38	0.48	2.37
Hy	2.20	7.65	2.23	4.43	4.20	6.21	12.32	5.39	2.74
Mt	1.18	3.51	1 36	2.08	2.15	2.93	3.60	2.70	2.78
Ilm	0.46	1.97	0 47	0.84	0.82	1.02	1.88	1.23	0.80
Ap	0.15	0.67	0 16	0.32	0.32	0.53	0.69	0.49	0.12
Sum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Analyses by D.Johnson, Washington State University. - = Location shown on Figure 1. Feo* = Total Fe as FeO.

Table 2. Major oxide and trace element analyses and CIPW norms, Tyonek D-6, D-7 and C-6 quadrangles.

Map No.	18	5	1	24	14	20	21	15	6
Sample	90DNS16a	90DNS44	90DNS55	90DNS66	90Ha112	90SAL13d	90SAL16	90MR103b	90MR117c
Quad	D-6	D-7	D-6	D-6	D-6	D-6	D-6	D-6	D-7
MAJOR OXIDES (weight percent)									
SiO2	76.4	41.2	62.7	70.7	61.1	50.4	73.2	45.9	47.4
Al2O3	12.5	8.83	16.5	13.9	16.2	16.8	14.1	15.1	10.0
CaO	0.24	18.1	4.71	1.19	4.46	7.87	0.47	12.1	13.3
MgO	0.07	9.53	2.73	0.18	2.60	5.37	0.14	8.02	11.2
Na2O	4.69	2.11	4.07	5.66	3.56	4.14	5.22	1.39	1.40
K2O	4.23	0.68	2.55	3.69	4.18	1.07	3.98	1.52	2.75
Fe2O3	1.15	2.67	1.30	2.78	2.06	2.67	1.58	2.13	2.29
FeO	0.1	5.6	3.3	0.7	3.2	7.5	0.4	8.8	8.3
MnO	0.04	0.17	0.12	0.13	0.09	0.21	0.04	0.20	0.20
TiO2	0.10	0.67	0.70	0.27	0.83	1.26	0.18	0.85	0.68
P2O5	0.02	0.29	0.22	0.04	0.21	0.28	0.03	0.25	0.33
LOI	0.39	9.70	0.62	0.85	0.77	1.85	0.54	2.54	1.54
Sum	99.9	99.6	99.5	100.1	99.3	99.4	99.9	98.8	99.4
TRACE ELEMENTS (ppm)									
Cr	<10	365	57	<10	68	21	<10	82	499
Rb	126	25	72	94	157	35	92	25	55
Sr	27	365	1130	131	491	1030	90	591	269
Y	39	<10	22	64	<10	12	18	17	10
Zr	185	33	162	335	294	78	229	27	45
Nb	12	25	20	36	17	27	15	<10	28
Ba	828	252	1020	1720	1160	543	1880	236	293
CIPW NORMS (weight percent)									
Qtz	32.63	0.00	14.63	21.99	11.43	0.00	26.65	0.00	0.00
Cor	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.00	0.00
Or	25.11	0.00	15.24	21.97	25.08	6.48	23.68	9.33	16.61
Ab	39.87	0.00	34.82	48.26	30.58	35.90	44.46	12.22	1.97
An	0.57	14.04	19.44	1.64	16.12	24.70	2.15	31.66	13.16
Lc	0.00	3.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ne	0.00	10.76	0.00	0.00	0.00	0.00	0.00	0.00	5.49
Ac	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wo	0.01	0.00	0.00	1.17	0.00	0.00	0.00	0.00	0.00
Di	0.38	53.74	2.23	0.97	4.00	11.01	0.00	23.69	42.04
Hy	0.00	0.00	9.89	0.00	7.66	5.03	0.35	2.97	0.00
Ol	0.00	6.34	0.00	0.00	0.00	9.80	0.00	14.66	15.24
Ca-orth	0.00	5.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mt	0.16	4.31	1.91	1.91	3.03	3.97	0.90	3.21	3.39
Hem	1.04	0.00	0.00	1.48	0.00	0.00	0.97	0.00	0.00
Ilm	0.19	1.42	1.34	0.52	1.60	2.45	0.34	1.68	1.32
Ap	0.05	0.75	0.52	0.09	0.49	0.67	0.07	0.60	0.78
Sum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
DISCRIMINANT SCORE (see text for explanation)									
Score:	*	*	96.2	*	73.2	100.0	*	100.0	*

Analyses by X-Ray Assay Laboratories, Ontario, Canada. ~=Location shown on Figure 1. *=Not applicable.

Table 2. Major oxide and trace element analyses and CIPW norms, Tyonek D-6, D-7 and C-6 quadrangles.

Map No.	7	3	-	-	4	9	-	-	-
Sample	90MR118c	90MR125c	90MR141c	90MR142c	90WG143f	90WG161	90WG166	90JK253	90JK257a
Quad	D-7	D-7	C-6	C-6	D-7	D-7	C-6	C-6	C-6
MAJOR OXIDES (weight percent)									
SiO2	48.0	75.6	72.0	66.2	49.2	57.4	76.3	75.4	76.2
Al2O3	11.3	12.1	14.2	15.7	13.4	18.0	12.8	13.1	12.5
CaO	7.75	0.59	1.33	2.10	10.1	5.98	0.32	0.88	0.28
MgO	9.72	0.35	0.47	0.78	5.34	2.02	0.07	0.23	0.13
Na2O	1.73	2.37	4.64	5.08	3.57	5.06	4.97	3.92	3.70
K2O	2.94	6.67	3.97	3.73	2.81	2.70	4.40	4.55	5.13
Fe2O3	2.60	0.42	1.23	1.31	4.10	1.25	1.02	1.04	1.04
FeO	11.8	0.8	1.2	2.5	5.2	4.6	0.3	0.4	0.3
MnO	0.23	0.02	0.08	0.10	0.16	0.20	0.05	0.03	0.04
TiO2	1.04	0.10	0.27	0.45	0.80	0.75	0.11	0.16	0.13
P2O5	0.30	0.02	0.07	0.10	0.39	0.26	0.02	0.04	0.03
LOI	1.31	0.93	0.85	1.31	4.39	1.62	0.16	0.47	0.39
Sum	98.7	100.0	100.3	99.4	99.5	99.8	100.5	100.2	99.9
TRACE ELEMENTS (ppm)									
Cr	219	<10	<10	<10	147	<10	<10	<10	<10
Rb	104	296	82	83	70	63	152	134	165
Sr	265	13	226	284	1550	927	<10	136	76
Y	<10	81	21	17	<10	26	39	35	39
Zr	61	172	218	367	42	129	213	127	126
Nb	27	31	13	34	13	33	12	15	25
Ba	574	225	1630	2380	513	664	295	486	382
CIPW NORMS (weight percent)									
Qtz	0.00	34.47	26.20	16.13	0.00	1.66	30.19	33.16	34.52
Cor	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.22	0.43
Or	17.84	39.80	23.59	22.48	17.47	16.24	25.91	26.95	30.47
Ab	15.03	20.25	39.47	43.84	22.15	43.59	41.19	33.25	31.47
An	14.77	2.71	6.17	9.20	12.87	18.76	0.00	4.12	1.20
Lc	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ne	0.00	0.00	0.00	0.00	5.21	0.00	0.00	0.00	0.00
Ac	0.00	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.00
Wo	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.00
Di	18.60	0.10	0.00	0.64	29.88	8.11	0.38	0.00	0.00
Hy	7.34	1.84	2.07	4.67	0.00	7.74	0.00	0.57	0.33
Ol	19.82	0.00	0.00	0.00	3.63	0.00	0.00	0.00	0.00
Ca-orth	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mt	3.87	0.62	1.79	1.94	6.25	1.85	0.81	0.93	0.72
Hem	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.40	0.55
Ilm	2.03	0.19	0.52	0.87	1.60	1.45	0.21	0.31	0.25
Ap	0.71	0.05	0.16	0.24	0.95	0.61	0.05	0.09	0.07
Sum	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
DISCRIMINANT SCORE (see text for explanation)									
Score:	100.0	13.7	0.1	80.5	*	99.9	*	*	*

Analyses by X-Ray Assay Laboratories, Ontario, Canada. -=Location shown on Figure 1. *=Not applicable.

Table 2. Major oxide and trace element analyses and CIPW norms, Tyonek D-6, D-7 and C-6 quadrangles.

Map No.	2	26	22	-
Sample	90MR124c	90MR130c	90SAL10c1	90JK225
Quad	D-7	D-6	D-6	C-6
MAJOR OXIDES (weight percent)				
SiO2	44.4	50.4	45.0	58.4
Al2O3	17.3	22.2	14.8	17.9
CaO	11.5	8.86	9.61	4.48
MgO	3.62	4.13	9.04	1.83
Na2O	2.75	2.98	1.22	4.10
K2O	0.61	1.20	3.29	3.06
Fe2O3	2.45	1.52	4.06	1.93
FeO	6.2	4.2	7.6	2.9
MnO	0.18	0.12	0.16	0.12
TiO2	1.61	0.66	1.40	0.79
P2O5	0.38	0.16	0.21	0.26
LOI	8.54	3.23	2.70	3.70
Sum	99.5	99.7	99.1	99.5
TRACE ELEMENTS (ppm)				
Cr	38	39	161	<10
Rb	13	38	64	61
Sr	766	917	371	657
Y	27	<10	20	26
Zr	136	70	48	163
Nb	20	<10	<10	14
Ba	419	1360	417	1980
CIPW NORMS (weight percent)				
Qtz	0.00	1.29	0.00	10.49
Cor	0.00	0.28	0.00	0.33
Or	3.96	7.35	20.17	18.88
Ab	25.57	26.15	8.23	36.22
An	36.33	44.50	26.13	21.43
Lc	0.00	0.00	0.00	0.00
Ne	0.00	0.00	1.35	0.00
Ac	0.00	0.00	0.00	0.00
Wo	0.00	0.00	0.00	0.00
Di	19.40	0.00	17.61	0.00
Hy	2.15	16.46	0.00	7.53
Ol	4.36	0.00	17.15	0.00
Ca-orth	0.00	0.00	0.00	0.00
Mt	3.90	2.29	6.11	2.92
Hem	0.00	0.00	0.00	0.00
Ilm	3.36	1.30	2.76	1.57
Ap	0.97	0.38	0.50	0.63
Sum	100.00	100.00	100.00	100.00
DISCRIMINANT SCORE				
Score:	100.0	100.0	*	84.0

Analyses by X-Ray Assay Laboratories, Ontario, Canada. -=Location shown on Figure 1. *=Not applicable.

Table 3. Description of analytical samples, Tyonek D-6, D-7 and C-6 quadrangles.

<u>Samples on Table 1:</u>

90DNS07: West of Dickason Mountain: Coarse- to medium-grained biotite diorite, contains $\approx$75% plagioclase, with clinopyroxene, orthopyroxene, olivine, biotite, quartz, alkali feldspar,and opaque oxides.

90DNS08: West of Dickason Mountain: Coarse- to medium-grained biotite diorite, very similar to 90DNS07.

90DNS17: Dickason Mountain: Granite porphyry, with $\approx$1mm phenocrysts of quartz and alkali feldspar.

90DNS31: Porcupine Butte: Porphyritic dacite, with phenocrysts of plagioclase, clinopyroxene and opaque oxides.

90DNS36: Ridge in central western Tyonek D-6 quadrangle: Porphyritic granodiorite, with phenocrysts of plagioclase, hornblende, biotite and opaque oxide in very fine-grained groundmass.

90DNS62: Hill 4180': Coarse-grained biotite granite with minor hornblende.

90Ha150: Eastern C-6 quadrangle: Coarse-grained hornblende biotite granite.

90JK175: Dickason Mountain: Granite porphyry with alkali feldspar, quartz and plagioclase phenocrysts.

90JK227: S. of Trimble Glacier: Very fine-grained andesite, containing plagioclase, biotite, clinopyroxene, quartz, amphibole and opaque oxides.

90JK228: S. of Trimble Glacier: Fine-grained granite with phenocrysts up to 4mm of quartz, plagioclase, alkali feldspar and biotite.

90MR114c: West of Dickason Mountain: Coarse- to medium-grained biotite quartz monzodiorite, containing plagioclase, quartz, alkali feldspar, biotite, clinopyroxene, olivine and opaque oxides.

90MR136c: N. of hill 3715': Medium-grained hornblende biotite granite.

90MR147c: Hill 3715': Fine-grained porphyritic hornblende biotite granite with alkali feldspar phenocrysts.

90SAL44a: E. edge of D-7: Porphyritic hornblende biotite granite, with alkali feldspar phenocrysts.

90SAL44b: E. edge of D-7: Fine-grained equigranular biotite granodiorite.

90SAL84a: S. of Hayes River Pass: Medium-grained hornblende biotite quartz diorite.

90WG119: Southeast corner of D-6: Porphyritic andesite with plagioclase phenocrysts.

90WG121: Southeast D-6: Medium-grained hornblende quartz monzonite.

<u>Samples on Table 2:</u>

90DNS16a: Dickason Mountain: Granite porphyry with phenocrysts of alkali feldspar and quartz.

90DNS44: Central west D-7: Porphyritic basalt with clinopyroxene phenocrysts up to $\approx$3mm.

90DNS55: Kichatna pluton, NW D-7: Fine-grained hornblende biotite granodiorite.

90DNS66: Southeast D-6: Porphyritic hornblende biotite quartz monzonite.

90Ha112: West of Dickason Mountain: Coarse- to medium-grained biotite quartz diorite, containing plagioclase, quartz, clinopyroxene, orthopyroxene, biotite, and opaque oxides.

90SAL13d: Central eastern D-6: Small plug or dike of porphyritic hornblende diorite.

90SAL16: Central eastern D-6: Fine-grained granite, color indix <3, pervasive graphic intergrowth.

90MR103b: Central D-6: Porphyritic hornblende clinopyroxene gabbro dike with microcrystalline groundmass.

90MR117c: Central eastern D-7: Porphyritic basalt with clinopyroxene phenocrysts.

90MR118c: Central eastern D-7: Porphyritic clinopyroxene hornblende basalt.

90MR125c: Central D-7: Aphanitic, spherulitic felsic dike, 2.5m thick, with embayed quartz phenocrysts up to 1.5mm.

90MR141c: Northeastern C-6: Porphyritic rhyolite with subrounded plagioclase, alkali feldspar and quartz phenocrysts up to 3mm, in aphanitic felsic groundmass.

90MR142c: Northeastern C-6: Fine- to medium-grained hornblende biotite monzodiorite.

90WG143f: Central eastern D-7: Porphyritic basalt with fine-grained clinopyroxene and opaque oxide phenocrysts.

90WG161: N. of Spring Creek: Fine-grained hornblende biotite quartz diorite, sericitically altered.

90WG166: Central C-6: Fine-grained alkali feldspar granite, color index $\approx$3.

90JK253: Central C-6: Fine-grained alkali feldspar granite with medium-grained phenocrysts of alkali feldspar and quartz. Color index $\approx$3.

90JK257a: Central C-6: Fine-grained alkali feldspar granite. Color index $\approx$3.

90MR124c: Central D-7: Porphyritic mafic dike with plagioclase phenocrysts up to 1cm.

90MR130c: Southwest D-6: Mafic dike bordering felsic dike. Porphyritic plagioclase in very fine-grained groundmass.

90SAL10c1: Eastern D-6: Porphyritic hypabbysal gabbro with hornblende and clinopyroxene phenocrysts.

90JK225: Central C-6: Porphyritic plagioclase diorite dike.

Tyonek D-6 and D-7 Map Unit Descriptions
(Public Data File 91-10, Plate 1)

Unconsolidated Deposits:

Qa	**Stream alluvium, undifferentiated:** Fluvially derived silt, sand and gravel of floodplains, terraces and fans. Grain size, degree of sorting and stratification vary according to stream size, flow regimen and the source of bedload material. Alluvium thickness varies from a few feet to several tens of feet. Unit includes some glacial outwash deposits.
Qaf	**Alluvial fan deposits:** Poorly- to moderately-sorted alluvial silt, sand and gravel deposited as deltoid fans where tributaries join higher order streams. Fan accumulations in mountain trunk valleys are generally poorly sorted, with material tending to be coarse, bouldery and more angular than materials that have been transported considerably farther from their source and contain a larger percentage of fine grained components .
Qcl	**Landslide deposits:** Chaotically deformed deposits derived from relatively sudden mass movement of material along a plane(s) of failure. Surfaces of Qcl deposits are characteristically hummocky and commonly lie below a well-defined failure scarp.
Qt	**Talus:** Angular, frost-riven bedrock transported by gravity down cirque headwalls, avalanche chutes, and steep slopes and gullies. Talus forms cones or aprons at or near angle of repose along valley walls.
Qrg	**Rock glaciers and rock glacier deposits:** Very coarse-grained deposits of unsorted, angular, frost-shattered material derived from former ablation moraine or talus. Active rock glaciers contain interstitial ice which enables them to move or flow by internal deformation. Sand and smaller grain sizes are scarce or absent near the surface, but become more prevalent a few feet below the surface.
Qrg'	**Rock glacier, older generation:** Inactive rock glacier deposits, differentiated from Qrg by more slumpy, eroded and vegetated morphology.
Qcd	**Colluvium and drift, undifferentiated:** Thick to thin deposits, unsorted, derived from mass-wasting processes and glacial and fluvial deposition. Unit mapped where it obscures bedrock. Thickly forested below about 2000 feet elevation.
Qd	**Undifferentiated glacial deposits:** Thick deposits of stratified and unstratified drift with low, commonly swampy, morphology. May include till, outwash, ice-contact, and glaciolacustrine sediments, as well as alluvial and colluvial deposits. Deposits mantled by accumulations of eolian and organic material.
Qdt	**Till:** Diamicton deposited directly by glacial ice. Characteristically unsorted to poorly sorted, composed of varying amounts of clay, silt, sand, gravel and boulders. Cobble and boulder size clasts commonly polyhedrally faceted and striated, sub-angular to sub-rounded. Forms lateral and terminal moraines deposited by active and recently active glaciers.

Intrusive Rocks:

Tif	**Felsic dikes:** Undeformed felsic dikes which in some cases can be traced for several kilometers. Generally light grey, commonly orange-weathering, fine-grained to aphanitic. Indicated on map (Plate 1) by line with cross-hatches.
TKd	**Biotite diorite:** Includes diorite, quartz diorite, quartz monzodiorite and quartz monzonite, over an area of about 7 square miles. Coarse- to medium-grained, with a fine-grained variant. Ranges from seriate to slightly porphyritic, with a granular texture; weathers locally to grus. Mafic rocks contain olivine, clinopyroxene, orthopyroxene, biotite and opaque oxides, with accessory apatite. Rocks with higher percentage of quartz and alkali feldspar contain amphibole and/or biotite, opaque oxide, and accessory apatite ± titanite, with less abundant or absent olivine and pyroxene. Alteration minerals include amphibole, sericite, iron oxides, and carbonate. $^{40}Ar/^{39}Ar$ age determination pending.
TKdgp	**Dickason granite porphyry:** Porphyritic granite on east side of Dickason Mountain. Contains 20 - 30 vol.% quartz and alkali feldspar phenocrysts (up to 1.0 cm) in a light grey, orange-weathering, very fine-grained groundmass. Color index <5. Mafic minerals, in the groundmass, include biotite, hornblende and opaque oxides. In thin section, alkali feldspars appear turbid; quartz phenocrysts are rounded, with resorption embayments. $^{40}Ar/^{39}Ar$ age determination pending.
TKqm	**Quartz monzonite:** Medium- to fine-grained, light grey, orange-weathering hornblende ± biotite quartz monzonite, which crops out in the southeast part of the D-6 quadrangle. Fine-grained variant is porphyritic, with plagioclase and quartz phenocrysts up to 2 mm. $^{40}Ar/^{39}Ar$ age determination pending.
TKpd	**Porcupine Butte dacite:** Porphyritic hypabyssal dacite(?) forms Porcupine Butte, an erosionally exposed volcanic neck, with prominant columnar jointing. Rock is dark grey, light orange-grey weathering, with phenocrysts of plagioclase, clinopyroxene, opaque, and ± quartz in a very fine-grained to aphanitic groundmass. $^{40}Ar/^{39}Ar$ age determination pending.
TKgp	**Granodiorite porphyry:** Medium green-grey, very fine- to fine-grained granodiorite with abundant phenocrysts of plagioclase (up to 1 cm), hornblende, biotite and opaque oxides. Crops out on ridge in central western part of D-6 quadrangle, and locally includes a fine-grained chloritic hornblende granodiorite with sparse small quartz and plagioclase phenocrysts. $^{40}Ar/^{39}Ar$ age determination pending of porphyry. Unit also includes porphyritic intermediate dikes and small plugs common throughout map area which have plagioclase and hornblende or biotite as predominant phenocrysts.
TKgd	**Hornblende biotite granodiorite:** Fine- to medium-grained seriate hornblende biotite granodiorite which crops out in northwest corner of D-6 quadrangle. Accessory minerals include apatite and titanite; secondary chlorite present locally. Granodiorite is contiguous with body mapped as one of the Kichatna plutons (TKk) by Reed and Nelson (1980; Map I-1174) in Talkeetna quadrangle.

TKg **Granite:** Granite, including a fine-grained equigranular biotite granite and a porphyritic biotite hornblende granite. Abundant phenocrysts in the latter are pinkish-grey alkali feldspar up to 2 cm long, with whitish-grey plagioclase up to 3 mm, and fine-grained interstitial groundmass. Crops out near central-eastern edge of D-7 quadrangle.

Layered Rocks:

Tk **Kenai Group sandstone, conglomerate, clay and coal:** Poorly to moderately indurated pebble to cobble conglomerate, cross-bedded medium-grained sandstone to granule conglomerate, clay layers and coal seams, exposed in isolated outcrops in southeast D-6 quadrangle and in bluffs along the Skwentna River. Coal is up to at least 5 m thick, generally silty and fissile. Basal clay layer contains fossil roots. Possible bentonite layer within coal seam. Assigned to Kenai Group based on lithologic similarity to Kenai Group rocks mapped by Barnes (1966) east of Dickason Mountain.

TKft **Felsic tuff:** Light greenish grey felsic tuffs, crystal tuffs and lapilli tuffs. Crystals include quartz, feldspar and minor hornblende. Lapillis are grey to green; lithic fragments are of sedimentary origin. Unit may include some fine-grained porphyritic felsic flows. Age uncertain, but may be extrusive equivalent of Dickason granite porphyry (TKdgp) and/or TKqm, due to close spatial relationships in eastern part of quadrangle. Unit also includes light grey lithic crystal tuff in lower Spring Creek.

TKa **Andesite:** Andesitic to basaltic volcanic(?) rock, along northeast margin of TKd. Dark grey, aphanitic and blocky, appears to be columnar jointed. Could be extrusive equivalent of nearby intrusives, or possible chill margin facies of TKd.

TKb **Basalt:** Dark green-grey aphanitic basaltic rock, locally appears to have pillows. Interlayered with Mesozoic sediments in southwest D-6 quadrangle.

TMzpa **Porphyritic andesite:** Abundant plagioclase and altered mafic mineral phenocrysts (up to 3 mm) in a dark grey, fine-grained to aphanitic groundmass; crops out in the southeast corner of the D-6 quadrangle. In thin section, groundmass has irregular banded texture locally, and may be devitrified glass.

TMzb **Clinopyroxene basalt:** Very dark grey to green-grey, very fine-grained to aphanitic basalt to andesite, with variable amounts of clinopyroxene and plagioclase phenocrysts up to 2 mm. Locally vesicular or amygdaloidal. Unit includes volcanic breccia and conglomerate. On ridge south of Spring Creek, volcanic rocks commonly weather purple-green, and include more andesitic-looking compositions. Unit may be correlative with Jurassic Talkeetna Formation. $^{40}Ar/^{39}Ar$ age determinations pending.

Ks **Sandstone, siltstone and shale:** Interbedded dark grey to black, locally greenish-grey, fine- to thickly bedded sandstone, siltstone and shale. Local granule to pebble conglomerate present. Unit is generally interpreted as turbidites. Unit locally may include undifferentiated Kca, KJsl, Kss, KJssh and KJcs. Age based on identification of Valanginian Buchia sublaevis Keyserling from coquina beds along the lower Chickak River, just west of the map area (unpublished report on fossils by William P. Elder to Dwight Bradley, U.S.G.S., 1989; fossils collected by Madelyn Millholland, Cominco Alaska Exploration).

Ksi **Sediment and intrusive, undifferentiated:** Mixed zone of Mesozoic sediments (mostly Ks) and intermediate to felsic hypabyssal intrusives, cropping out at unmappable scale.

Kca **Cherty argillite:** Dark grey to black, thinly bedded dense cherty argillite. On ridge north of Old Man Creek, argillite is highly sheared. Commonly pyritiferous. Dense texture may locally reflect thermal effects of nearby intrusives; elsewhere, appears to be a facies of the Cretaceous sedimentary package. A sample of Kca from central western D-6 quadrangle yielded no radiolaria.

Kss **Green sandstone:** Massive, medium to dark green-grey lithic feldspathic sandstone, commonly with up to about 15% black elongate shaley clasts. Ranges from fine-grained sandstone to unsorted pebble conglomerate. Clastic material includes abundant subangular plagioclase and quartz grains and black shale, with lesser amounts of chert, limestone, biotite, and mafic volcanic. Locally contains sparse pyrite. Sandstone is interbedded with thinly bedded dark green-grey and black siltstone and mudstone typical of the Ks unit. Unit is shown only where sandstone is predominant and mappable. Elsewhere in Ks and KJcs, similar feldspathic lithic sandstone is common but more thinly bedded. Hornfelsed proximal to intruding dikes. Kss which overlies mafic volcanics (TMzb) on ridge south of Spring Creek contains abundant bluish-grey chert clasts. In southwest corner of D-6 quadrangle, Kss contains elongate black calcareous nodules up to 15 cm long. Age uncertain, but assigned to Cretaceous based on interbedded relationship with Ks unit.

KJssh **Sandstone and shale:** Interbedded sandstone and shale interval overlying KJcs, with repeated cycles of massive sandstone thinning and fining upward to shale. Each massive sand bed does not appear to be erosive into underlying shale; load casts observed locally.

KJcs **Conglomerate and sandstone:** Interbedded granule to boulder conglomerate and fine- to coarse-grained sandstone, with minor shale. Grades up to KJssh unit. Boulder conglomerates appear to be channel fills. Repeated thinning- and fining-upward cycles from conglomerate to shale, each cycle over about 5 to 15 m, with apparent overall thickening and fining westward in D-7 quadrangle. Locally beds appear overturned. Conglomerate clasts are rounded to subrounded, and include mafic volcanic rock, sandstone, felsic and intermediate intrusive rock, quartzite, chert, shale, conglomerate, and limestone. Matrix is sandy, medium to dark greenish-grey, and unsorted. Internal structures in conglomerates were not visible. Sandstone beds are massive, cross-bedded and graded, from 0.5 to 1.0 m thick. Sandstone contains clastic subangular grains of plagioclase, quartz, biotite, clinopyroxene, hornblende, black shale, limestone, chert, and possible alkali feldspar. Unit contains local calcareous concretions. May locally include KJssh. Age uncertain; $^{40}Ar/^{39}Ar$ age determinations on igneous clasts from within conglomerate pending. Unit in bluffs of Skwentna River is highly sheared, and may be a different part of the sedimentary section, with a somewhat different provenance, yielding more mafic volcanic and fewer felsic intrusive clasts.

KJsl **Shale, siltstone** and limestone: Interbedded dark grey, very thin to medium-bedded shale, siltstone and limestone. Unit includes minor sandstone. In western D-6 and eastern D-7 quadrangles, this unit appears to underlie KJcs, with undetermined relationship, and may pre-date TMzb, based on presence of pyroxene-porphyritic dike in KJsl which could be feeder to TMzb. In southwestern corner of D-6 quadrangle, KJsl appears to be part of the Cretaceous sedimentary package.