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RECONNAISSANCE GEOLOGY AND GEOCHEMISTRY OF FORRESTER ISLAND NATIONAL WILDLIFE REFUGE. ALASKA

By

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Introduction

During the summer of 1969, a Geological Survey field party visited the Forrester Island National Wildlife Refuge, Alaska, in the course of the geologic mapping of Dall Island. A brief description of the geology of Forrester Island (Cobb and others, 1968, p. K24-K28) indicated that it constituted part of the regional framework of Dall Island, and the visit was made for the purpose of establishing that framework.

The Forrester Island National Wildlife Refuge is located in the Pacific Ocean near latitude 50°50' N. and longitude 133°30' W. about 85 miles southwest of Ketchikan, Alaska.

The refuge is composed mainly for Forrester Island, which is about 5 miles long and 1-1/2 miles wide with a total area of approximately 4 square miles, and Lowrie and Petrel Islands, each less than 160 acres in area.

Except for the shorelines, Forrester Island is densely covered by trees, shrubs, or muskeg. There are no roads, but a trail leads from Eagle Harbor (fig. 1) to an inactive military installation on the ridge crest.

Geology

Approximately 80 percent of Forrester Island is underlain by intrusive igneous rocks. Medium- to light-colored quartz monzonite is the dominant igneous rock type. Typically two distinct varieties are present, a coarse-grained porphyritic phase, which has potassium feldspar phenocrysts up to 1 inch in length, and a fine- to medium-grained equigranular phase. The contact between the two phases is generally transitional within 6 inches but is locally sharp and marked by a dark biotite-rich zone approximately 1 to 1-1/2 inches wide.

Numerous other phases were observed, ranging in composition from granite to biotite-hornblende diorite. These phases appear to be local and are most common near the margins of the intrusive body.

Helicopter stops on Lowrie and Petrel Islands were also made, and both islands were found to be underlain by quartz monzonite similar to that described for Forrester Island.

On the north and northeast end of Forrester Island the quartz monzonite body cuts a dark- to light-green metaconglomerate. The contact zone is marked by numerous small faults and shears that are strongly limonite stained and contain minor pyrite. Near the contact the metaconglomerate is strongly hornfelsed and contains numerous epidote and quartz veins.

The metaconglomerate weathers to a mottled light and dark green with the light green areas representing primarily the original matrix and the dark green areas representing clasts. Clasts range from sand size to larger than 1 foot in diameter; the average size is approximately 2 to 3 inches in diameter. The clasts are primarily relict limestone with minor amounts of granite, greenstone, and argillite. The matrix is very fine-grained biotite, epidote, and feldspar. In the hornfelsed aureole there is a strong development of calc silicates and garnet.

The metaconglomerate is cut by numerous quartz veins ranging in thickness from 1/8 inch to 4 inches. Many of the quartz veins contain disseminated molybdenite.

The ages of the metaconglomerate and of the granitic intrusive rocks are not known with any certainty. Based on information derived from elsewhere in the region, however, the metaconglomerate is considered to be of original Early Paleozoic age and the intrusive rocks are probably of Mesozoic or Cenozoic age.

Mineral resources

During the present investigation, previously unknown small occurrences of molybdenite were discovered on the northern portion of Forrester Island.

Molybdenite mineralization was observed in three areas: in a small embayment approximately 1/2 mile north of Wood Cove (fig. 1, sample loc. 6 and 7), 200 yards west of Forrester Point (sample loc. 8), and at sample locality 9. The largest zone of molybdenite mineralization is the area near sample locality 6.

Near locality 6, stockwork-type quartz-vein molybdenite mineralization occurs over an area approximately 300 by 100 feet.

The host rock ranges from a porphyritic quartz monzonite to granodiorite and is generally strongly propylitically altered.

The host rock is cut by four distinct types of veinlets; quartz-molybdenite, quartz-pyrite-molybdenite, epidote, and pyrite. Quartz-pyrite-molybdenite and epidote veinlets are the most common. The density of veining ranges from 1-2 per $ft.^2$ to local areas of 10-14 per $ft.^2$. The average density is 4-8 per $ft.^2$ with approximately half of the veinlets containing megascopically visible molybdenite.

The entire area is strongly pyritized with pyrite occurring within veinlets and also as disseminations throughout the host rock.

In polished section study of mineralized specimens, the following minerals were identified: pyrite, magnetite, molybdenite, chalcopyrite, and pyrrhotite.

Molybdenite occurs as isolated fibers 3x20 microns in size and as aggregates which form 1/32-inch thick veinlets near the margin of quartz veinlets. Minor molybdenite occurs disseminated through the host rock.

Pyrite occurs in masses up to 1x3 mm. in size but varies down to single isolated crystals a few microns in diameter; most of the pyrite scattered through the rock occurs in masses about 0.3 mm. in diameter. The shape of the pyrite grains varies from strictly euhedral to highly rounded (corroded ?) forms throughout its size range. Occasionally the pyrite contains rounded to angular inclusions of chalcopyrite 10-50 microns in diameter and two similar sized blebs of pyrrhotite were seen in the pyrite. Chalcopyrite also occurs as tiny isolated fragments in the gangue occasionally.

Locally, patches up to 1 mm. in diameter consist of highly irregular, rounded grains of magnetite 3-50 microns in diameter separated by ramifying veinlets of gangue 5-10 microns in width.

Analyses of 11 samples (sample no. 6, table 1) shows that the molybdenum content of the rocks ranges from 5 to 500 parts per million with an average content of approximately 200 ppm (0.02 percent).

At locality 7, molybdenite occurs in large quartz veins ranging from 1 inch to 6 inches in thickness which transect the hornfelsed metaconglomerate. The density of quartz-molybdenite-pyrite veining is approximately 1-2 per $ft.^2$. Molybdenite occurs as small disseminated flakes and as thin veinlets throughout the quartz veins. Analyses of molybdenite-bearing quartz veins (sample no. 7, table 1) range from 500 to 700 ppm molybdenite.

Other anomalous amounts of molybdenum were encountered at sample localities 8 and 9 (fig. 1, sample nos. 8, 9, table 1) and probably reflect the presence of fine-grained molybdenite in quartz veinlets or are associated with pyritized areas of quartz monzonite.

Economic potential of the area

Although anomalous amounts of molybdenum were found in rock samples and molybdenite was observed in two localities, the economic potential of the area is believed to be very small. The following reasons substantiate this conclusion:

1. Analyses of the highest grade specimens found indicated only 700 parts per million molybdenum (0.07 percent) and the average molybdenum content of mineralized rocks is approximately 200 ppm (0.02 percent). Most molybdenite mines now require average grades of at least 1,500 ppm (0.15 percent) molybdenum for economic operation. The grade, therefore, appears to be only half that necessary for operation under current conditions and is well below that anticipated to be minable in the future.

2. The anomalous areas are small and near tidewater and, consequently, are of small tonnage potential.

3. The area is extremely remote and typified by harsh climatic conditions.

4. The entire Forrester Island area is very small and, therefore, the chance of large undiscovered deposits is small.

All of these factors suggest that the economic potential of Forrester Island is very low.

Reference cited

Cobb, E. H., Wanek, A. A., Grantz, Arthur, and Carter, Claire, 1968, Summary report on the geology and mineral resources of the Bering Sea, Bogoslof, Simeonof, Semidi, Tuxedni, St. Lazaria, Hazy Islands, and Forrester Island National Wildlife Refuges, Alaska: U.S. Geol. Survey Bull. 1260-K, p. K24-K26.

Table I. Analyses of samples, Forrester Island, Alaska

Analysts: Semiquantitative spectrographic analyses were done by K. J. Curry and atomic absorption analyses were done by R. L. Miller, R. B. Tripp, H. D. King, A. L. Meier, D. G. Murrey, and J. R. Hassemer.

Analyses, unless noted, are semiquantitative spectrographic and are reported in the series 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, and so on, or by the following symbols: N = not detected; L = detected but below limit of determination; - = not looked for; > = greater than

No.	Lab. No.	Field No.	Ag	As	Au[1]	B	Ba	Be	Bi	Co	Cr	Cu	Hg	La	Mo	Mn	Nb	Ni	Pb	Sb	Sc	Sn	Sr	V	W	Y	Zn	Zr	Fe	Mg	Ca	Ti
			Parts per million																										Percent			
1	ANG 259	Gx 191	L	N	L(.02)	N	700	L	N	N	L	L		N	L	300	L	10	L	N	N	N	150	20	N	10	N	70	2	.7	.7	.15
2	260	Gx 192	N	↓	↓	N	2000	N	↓	7	L	L		20	L	1500	10	L	N	↓	15	↓	700	150	↓	20	N	70	10	2	3	.5
2	261	Gx 192A	L	↓	↓	N	200	N	↓	15	70	200		N	N	1000	L	30	N	↓	15	↓	300	100	↓	L	L	50	7	3	2	.5
3	262	Gx 193	N	↓	↓	L	700	N	↓	15	10	L		20	L	1000	10	10	N	↓	15	↓	700	150	↓	15	N	200	10	3	3	.7
4	263	Gx 194	N	↓	↓	N	150	N	↓	50	L	30		N	L	1500	10	10	L	↓	20	↓	500	150	↓	10	L	L	15	5	3	.3
4	264	Gx 194A	N	↓	↓	N	150	N	↓	20	L	10		N	N	700	10	5	N	↓	15	↓	300	150	↓	15	N	20	10	3	2	.5
5	265	Gx 195	N	↓	↓	N	1500	N	↓	L	L	L		20	N	1000	10	5	10	↓	15	↓	300	150	↓	20	N	150	7	1.5	1.5	.7
6	247	Cx 280A	N	↓	↓	10	500	L	↓	10	70	10		N	70	1000	L	20	15	↓	15	↓	300	150	↓	15	N	70	5	2	5	.5
6	248	Cx 280B	N	↓	↓	10	300	L	↓	15	L	200		L	L	1500	10	L	L	↓	20	↓	500	150	↓	30	N	100	15	2	3	1
6	249	Cx 280C	N	↓	↓	L	500	N	↓	7	15	L		N	N	500	10	15	N	↓	5	↓	300	70	↓	10	N	70	5	1	1.5	.3
6	ANG 250	Cx 280D	N	N	L(.02)	N	1000	L	N	7	L	30		20	500	200	10	L	L	N	5	N	300	100	N	15	N	100	5	.7	1	.3
6	251	Cx 280E	N	↓	↓	↓	700	1	↓	L	L	10		20	15	600	10	N	10	↓	5	↓	500	100	↓	15	N	300	3	.7	1.5	.3
6	252	Cx 280F	N	↓	↓	↓	300	N	↓	5	L	15		20	N	700	L	N	L	↓	5	↓	300	70	↓	15	N	70	5	1.5	1.5	.5
6	253	Cx 280G	N	↓	↓	↓	1000	L	↓	7	L	L		20	L	1000	10	5	10	↓	7	↓	500	100	↓	15	N	200	7	1.5	1.5	.5
6	254	Cx 280H	N	↓	↓	↓	150	N	↓	20	L	70		N	200	500	10	5	N	↓	7	↓	200	70	↓	15	N	150	7	1	1	.5
6	255	Cx 280I	N	↓	↓	↓	500	N	↓	15	L	15		N	200	500	L	L	L	↓	L	↓	200	70	↓	10	N	70	7	1	1	.3
6	256	Cx 280J	L	↓	↓	↓	700	L	↓	15	L	200		N	200	700	L	L	N	↓	N	↓	200	50	↓	10	N	70	5	.7	1.5	.15
6	271	Cx 280K	N	↓	↓	↓	150	N	↓	N	L	L		N	150	150	10	5	N	↓	N	↓	L	20	↓	L	N	50	1.5	.05	.15	.07
7	257	Cx 281A	N	↓	↓	↓	300	1	↓	L	15	30		N	700	1000	L	15	N	↓	5	↓	150	50	↓	L	N	70	3	.7	1.5	.2
7	258	Cx 281B	N	↓	↓	↓	700	L	↓	20	70	70		N	500	1500	L	20	10	↓	15	↓	300	150	↓	10	L	70	10	3	3	.5
8	ANG 243	Bg 351	N	N	L(.02)	N	700	N	N	L	20	30		N	L	500	10	L	L	N	5	N	200	70	N	15	N	200	5	.7	1	.7
8	244	Bg 351a	N	↓	↓	N	700	N	N	30	50	70		N	L	1000	L	30	10	↓	20	↓	500	200	N	10	L	20	10	3	2	.7
8	245	Bg 351d	N	↓	↓	L	300	L	30	N	10	L		N	70	700	10	N	L	↓	7	↓	300	70	N	10	L	100	10	1	1.5	.3
8	246	Bg 351e	1	↓	↓	N	100	N	500	7	10	30		N	200	20	10	L	20	↓	N	↓	L	15	70	N	500	L	15	L	.1	.03
9	242	Bg 350	N	↓	↓	N	1000	L	N	15	10	L		30	10	700	15	L	10	↓	7	↓	500	100	N	30	N	200	10	1	1.5	.7
10	270	Gx 198	N	↓	↓	N	700	N	N	7	10	L		N	L	1000	10	L	N	↓	10	↓	500	70	N	15	N	100	5	2	2	.3
11	269	Gx 197	N.	↓	↓	N	1500	N	N	N	L	L		N	N	700	10	5	15	↓	L	↓	200	30	N	15	N	70	3	.7	1	.5
12	266	Gx 196A	N	↓	↓	N	1500	L	N	N	L	L		L	N	500	L	L	L	↓	N	↓	700	20	N	10	N	100	2	.7	1.5	.15
12	267	Gx 196B	N	↓	↓	N	1000	L	N	L	10	L		N	N	500	10	N	L	↓	N	↓	300	30	N	10	N	70	3	.7	1	.2
12	268	Gx 196C	N	↓	↓	N	700	L	N	N	L	L		N	N	500	10	L	L	↓	L	↓	300	30	N	L	N	70	3	.7	.7	.7
Limits of determination			.5	200	.02	10	5	1	10	20	5	5	5	20	5	10	10	2	10	100	5	10	50	10	50	10	200	20	.05	.02	.05	.001

[1] Atomic absorption

List of rocks analyzed in Table 1

(All samples are grab samples from natural outcrops)

Sample No.	Field No.	Rock type
1	Gk191	Coarse-grained quartz monzonite
2	Gk192	Coarse-grained quartz monzonite
2	Gk192A	Fine-grained porphyritic andesite dike
3	Gk193	Hornblende diorite
4	Gk194	Hornblende diorite
4	Gk194A	Hornblende diorite
4	Gk195	Coarse-grained porphyritic quartz monzonite
6	Ck280A	Epidote-rich hornfels
6	Ck280B	Hornfelsed metaconglomerate
6	Ck280C	Porphyritic granodiorite
6	Ck280D	Quartz-pyrite-molybdenite veinlet in quartz monzonite
6	Ck280E	Pyritic quartz monzonite
6	Ck280F	Pyritic quartz monzonite
6	Ck280G	Pyritic quartz monzonite
6	Ck280H	Quartz-pyrite-molybdenite veined quartz monzonite
6	Ck280I	Quartz-pyrite-molybdenite veined quartz monzonite
6	Ck280J	Quartz-pyrite-molybdenite veined quartz monzonite
6	Ck280K	Quartz-pyrite-molybdenite veined quartz monzonite
7	Ck281A	Quartz vein with pyrite and molybdenite
7	Ck281B	Molybdenite-bearing hornfelsed metaconglomerate

List of rocks analyzed in Table 1 (cont'd)

Sample No.	Field No.	Rock type
8	Bg351	Hornfelsed metaconglomerate, iron stained
8	Bg351A	Pyritic hornfelsed metaconglomerate
8	Bg351D	Pyrite-molybdenite bearing porphyritic quartz monzonite
8	Bg351E	Pyrite-quartz vein
9	Bg350	Medium-grained biotite quartz monzonite
10	Gk198	Hornblende biotite granodiorite
11	Gk197	Porphyritic quartz monzonite
12	Gk196A	Porphyritic quartz monzonite
12	Gk196B	Fine-grained quartz monzonite
12	Gk196C	Biotite-rich contact zone