MINERAL OCCURRENCES IN THE UPPER WOOD RIVER, EDGAR CREEK, AND WEST FORK GLACIER AREAS, CENTRAL ALASKA RANGE

By
K.W. Sherwood, Campbell Craddock, and T.E. Smith

SPECIAL REPORT 14

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By K.W. Sherwood,[1] Campbell Craddock,[1] and T.E. Smith

ABSTRACT

Geologic mapping and geochemical sampling in the central Alaska Range have identified several mineralized areas near the headwaters of the Wood River, Edgar Creek, and at the head of the West Fork Glacier. Geochemical samples collected from these sites contain significant concentrations of copper, silver, and gold. Metalliferous zones include: (1) all rocks adjacent to gabbro sills and granodiorite plutons, (2) the interior of gabbro sills, and (3) subsidiary fracture zones related to the Hines Creek Fault. This report provides locations and a general description of these mineral occurrences as well as elemental analyses of selected samples.

INTRODUCTION

Geologic mapping in the upper Wood River and Edgar Creek areas was carried out by K.W. Sherwood and Campbell Craddock of the University of Wisconsin in 1973, funded through National Science Foundation Research Grant GA-28966, awarded to Craddock.

Geochemical sampling was conducted by Sherwood and by T.E. Smith and T.K. Bundtzen of the Alaska Division of Geological and Geophysical Surveys.

Atomic absorption analysis of samples was performed by T.C. Trible at the DGGS Mineral Analysis and Research Laboratory in College. A 10-gram sample was digested with an appropriate amount of aqua regia. The digestate was diluted to 100 milliliters with distilled H_2O and centrifuged. The elements copper, lead, zinc, silver, and nickel were aspirated directly into an air-acetylene flame while gold was determined following a DIBK/Aliquot 336 solvent-solvent extraction. Optical emission spectrographic analyses of all samples were performed by Spe Comp Services, Inc. of Steamboat Springs, Colorado using a 1.5-meter Wadsworth Mounted Jarrell-Ash DC arc emission spectrograph.

The area of investigation (fig. 1) includes some of the highest topographic relief in the central Alaska range. No roads exist in the general area, although the Denali Highway passes along the flank of the range a few kilometers to the south. Fixed-wing aircraft can land on airstrips on the Wood and Delta Rivers. Much of the field work was helicopter supported.

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GENERAL GEOLOGY

UPPER WOOD RIVER AREA

The bedrock geology near the head of the Wood River consists of two distinct terranes, separated by major east-west discontinuity known as the Hines Creek Fault (fig. 2). The Hines Creek Fault is considered to be an ancient and presently inactive segment of the Denali Fault System; an active trace of this system, the McKinley Strand, lies 29 kilometers to the south.

The terrane north of the Hines Creek Fault is divided into the following three rock units: 1) the Birch Creek Schist, a highly deformed assemblage of quartzites and pelitic phyllites of undetermined age; 2) a monolithologic unit of black phyllites, possibly of Devonian age (Wahrhaftig, 1968); and 3) an upper Devonian (Hickman, 1974) sequence of metavolcaniclastic rocks of felsic to intermediate compositions.

The Birch Creek Schist (bc) has undergone multiple deformations, and a secondary foliation (S_2) forms the most conspicuous mesoscopic structural element of these rocks. The black phyllites (Dbp) are also strongly deformed and possess a well-developed primary foliation (S_1) locally overprinted by a secondary cleavage (S_2). The most conspicuous structural element of the metavolcanic rocks (Dmv) is a single primary foliation (S_1) parallel to compositional banding.

The terrane south of the Hines Creek Fault has been divided into four rock units: 1) a strongly deformed sequence of cherts and pyrophyllitic phyllites (Pc) of probable early Paleozoic age; 2) a folded sequence of metagraywackes, slates, and calcarenites (Om) of possible Ordovician age, based on possible graptolite imprints (Anderson, 1973) [highly sheared rocks (sh) probably belongs to this unit and may represent the base of a thrust sheet]; 3) a voluminous swarm of west-trending gabbro sills (ga), possibly emplaced during the Triassic (Wahrhaftig, 1970); and 4) the Paleocene Cantwell Formation (Tc), a mildly folded sequence of conglomerates, sandstones, and carbonaceous shales preserved as small in-faulted outliers within the older metamorphic-igneous terrane. Triassic(?) gabbros similar to those described above can be found to the west in

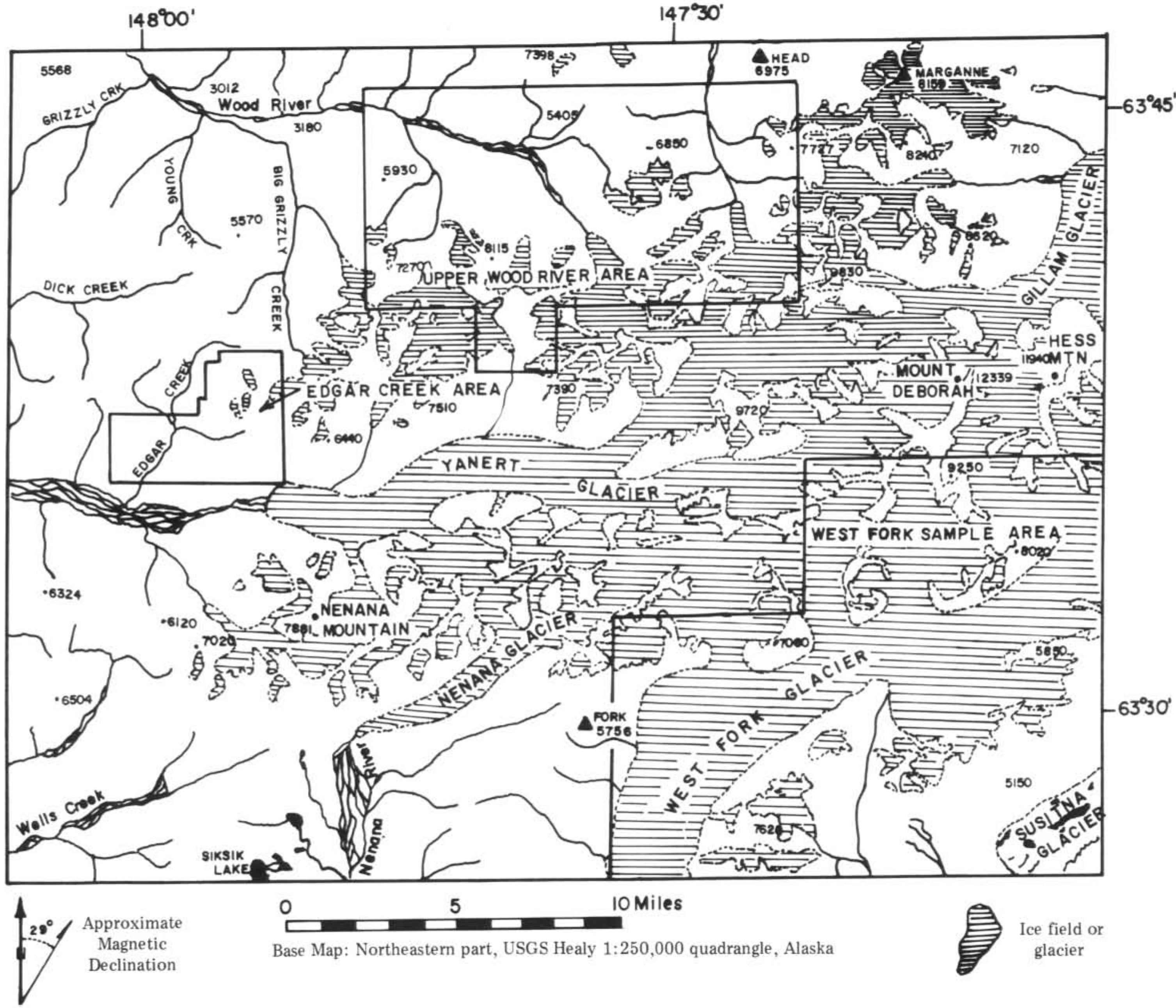

Figure 1. Location map showing areas described in this report.

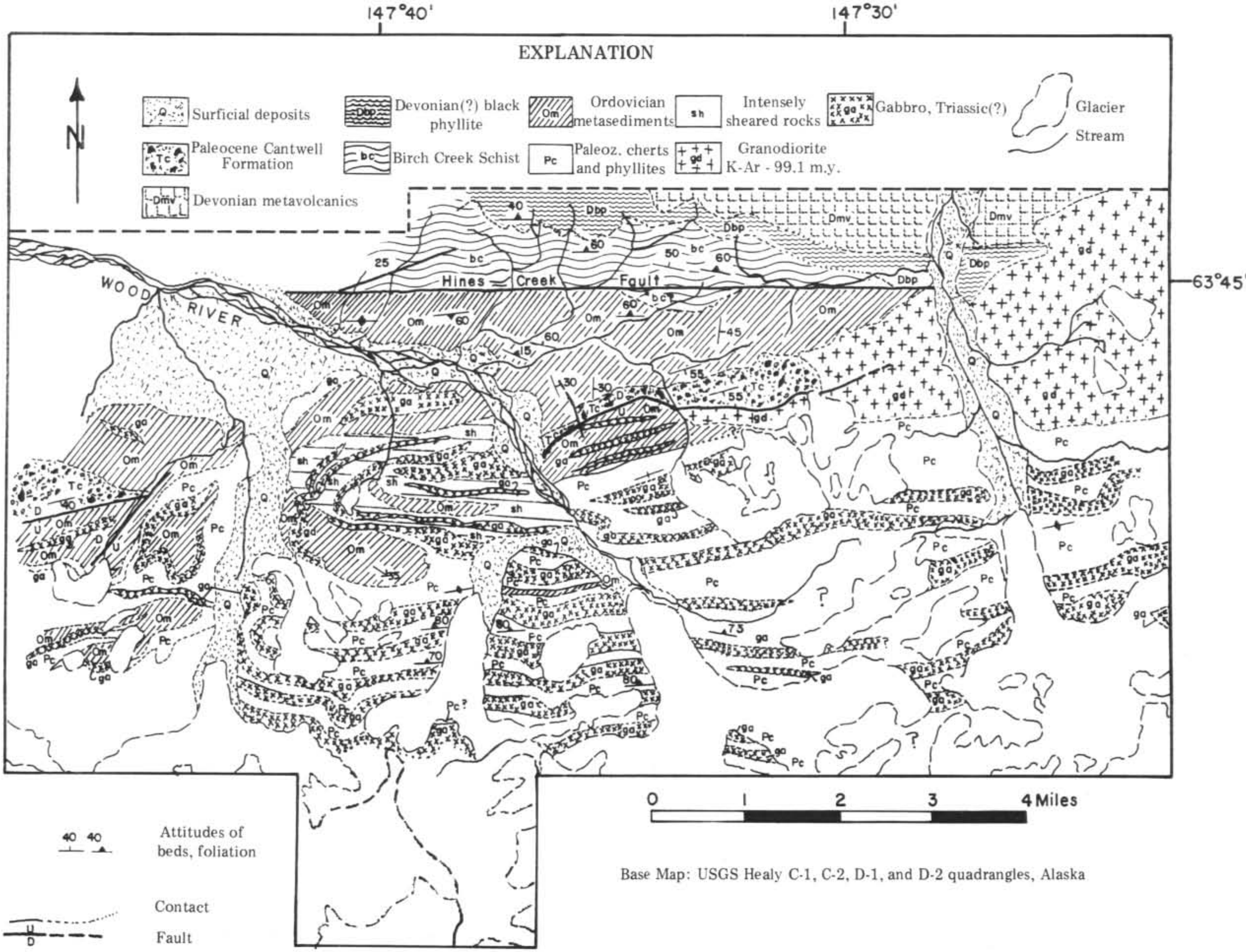

Figure 2. Generalized geology, upper Wood River area.

Mt. McKinley National Park (Wyatt Gilbert, personal communication).

The structure of the pre-Cantwell rocks is complex. The pre-Ordovician(?) cherts and phyllites (Pc) apparently sustained multiple deformations prior to deposition of the Ordovician(?) graywackes, shales, and calcarenites (Om). The Ordovician(?) strata (Om) and intrusive Triassic(?) gabbro sills (ga) have been deformed into tight recumbent folds and are locally overthrust by the older cherts and phyllites (Pc).

A large granodiorite body (gd) known as the Buchanan Creek Pluton (Wahrhaftig and others, 1974), of middle Cretaceous age, truncates the Hines Creek Fault in the eastern part of the area (fig. 2).

During the Paleocene, the coarse detritus of the Cantwell Formation accumulated on an erosional surface of the older rocks. The presence of minor angular unconformities within the Cantwell Formation suggests that recurrent tilting accompanied deposition. The Cantwell rocks have subsequently been deformed into asymmetrical folds and are locally truncated by reverse faults.

EDGAR CREEK AREA

The bedrock geology of the Edgar Creek area (fig. 3) is very similar to that of the upper Wood River area, and mapping has delineated four distinct rock units similar to those found in that location: 1) a highly deformed assemblage of cherts and pyrophyllitic phyllites (Pc) of probable early Paleozoic age; 2) a sequence of Ordovician(?) (Anderson, 1973) metagraywackes, slates, and calcarenites (Om), locally conglomeratic (mc) near the base; 3) a swarm of northeast-trending steeply inclined gabbro sills (ga) of possible Triassic age (Wahrhaftig, 1970); and 4) the Paleocene Cantwell Formation (Tc), a folded sequence of conglomerates, sandstones, and carbonaceous shales. Unconformities are inferred at the base of the Ordovician(?) rocks (Om) and at the base of the Cantwell Formation.

AEROMAGNETICS

A regional aeromagnetic map is shown in figure 4 for the general vicinity. A 400-gamma magnetic high outlines the Cretaceous Buchanan Creek Pluton of the upper Wood River area (figs. 2 and 4).

The swarms of gabbro sills present at Edgar Creek and the Wood River are reflected by the small aeromagnetic highs, usually less than 100 gammas in magnitude, that form a diffuse southwesterly trend which extends from Edgar Creek to the southeastern end of the upper Wood River map area.

MINERAL OCCURRENCES

Much of the sulfide mineralization in the upper Wood River and Edgar Creek areas seems to be within contact zones adjacent to gabbro sills and the Buchanan Creek Pluton. Subsequent weathering and oxidation of the sulfidized contact rocks have produced conspicious limonitic staining in the bedrock of these areas. The localities of such outcrops have been mapped as "gossan" on figures 5 and 6. Some sulfide-rich outcrops associated with gabbro bodies contain abundant pyrrhotite and lesser amounts of chalcopyrite.

In the north-central part of figure 5 and in figure 6, a second type of mineralization not directly related to igneous bodies occurs within fracture zones subsidiary to the Hines Creek Fault. At several such locations in the upper Wood River and Edgar Creek areas, malachite was observed along fracture fillings and foliations of the metasedimentary rocks. Although most of these showings were considered to be of low grade and were not sampled, each observation has been identified by the elemental symbol for copper (Cu) on both figures 5 and 6.

Four grab-sample sites are located in the vicinity of West Fork Glacier (fig. 7). Two of these samples, map numbers 29 and 30, are of rock debris on the glacier itself; the debris source has been indicated on figure 7. Samples from the above four sites have a high metal sulfide content. Their field occurrences are marked by conspicuous iron-stained "gossan" zones in the debris and on the slopes.

RESULTS AND CONCLUSIONS

The analytical results for the samples collected during this study are shown in tables 1 and 2. Although none of the samples analyzed bears economic concentrations of base or precious metals, the presence of the many mineralized zones described above may indicate the existence of large and richer deposits of economic significance.

Information on the structural and geologic setting of the mineral occurrences described in this report is useful in that it may be used to establish guidelines for future investigations. The following targets are suggested as a basis for mineral evaluation in this area: 1) the wall rocks adjacent to gabbro sills and granodiorite plutons; 2) the interior of differentiated gabbro sills (potential concentrations of primary metallic oxides and sulfides); and 3) those areas within fracture zones adjacent to major faults such as the Hines Creek Fault.

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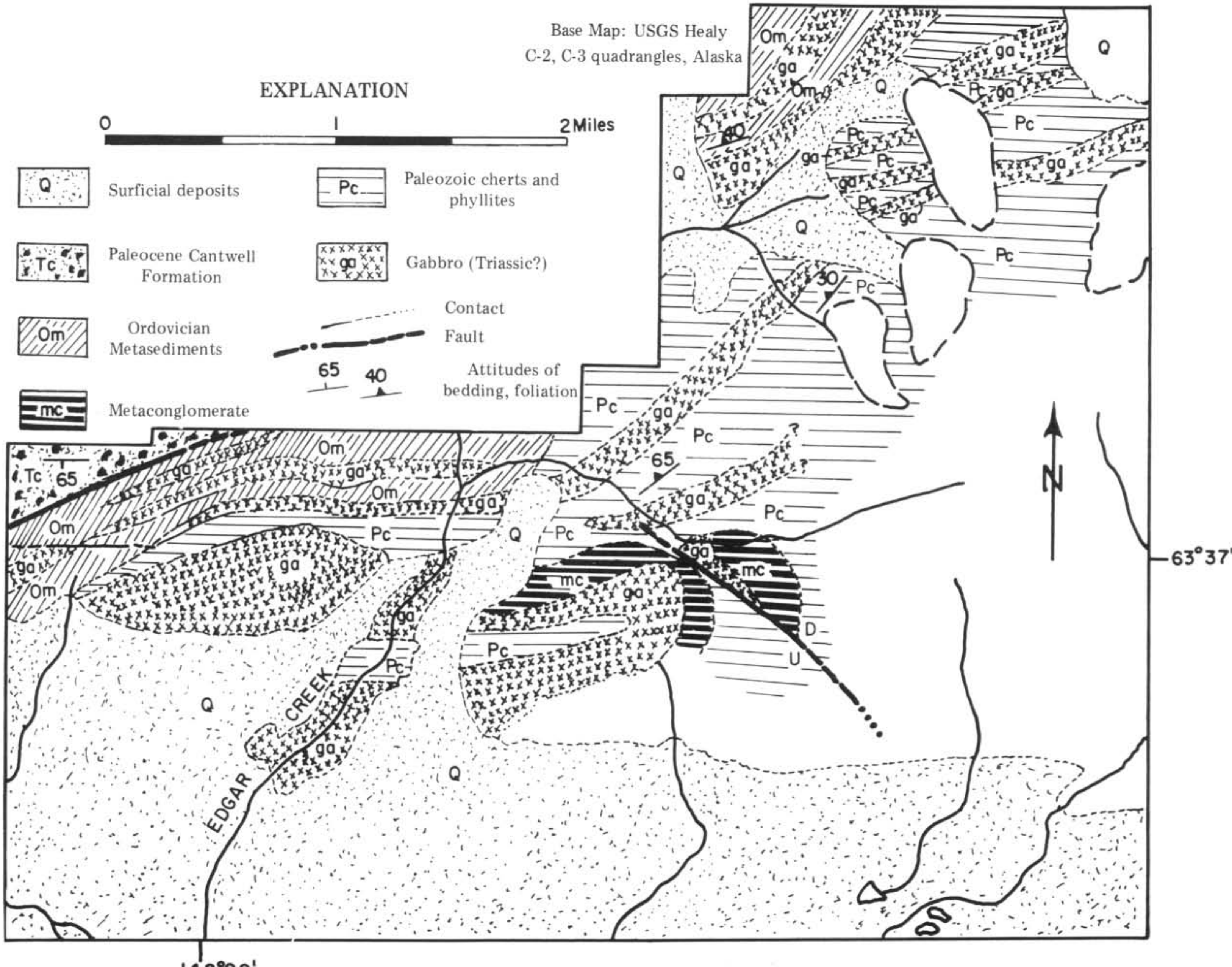


Figure 3. Generalized geology, Edgar Creek area.

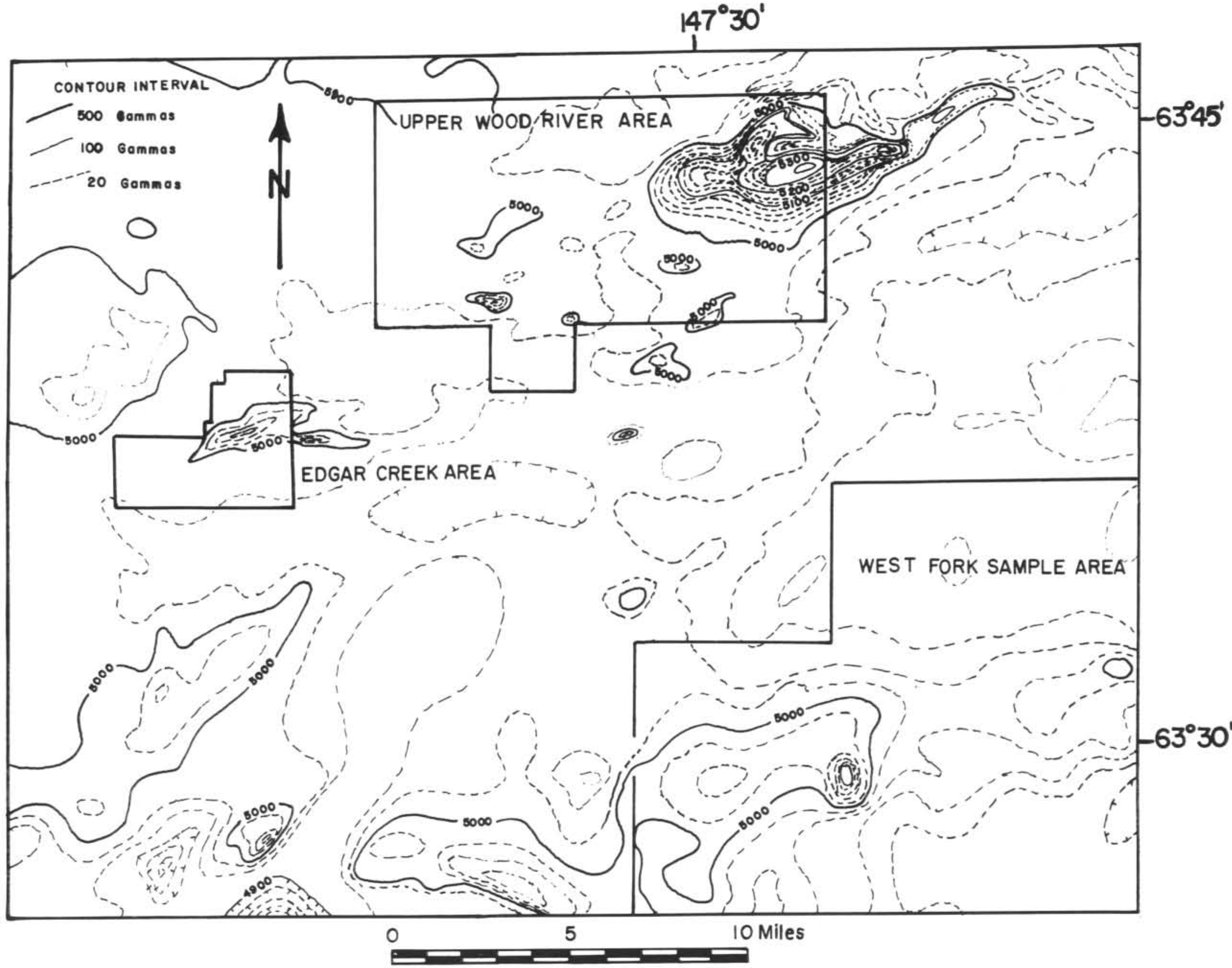
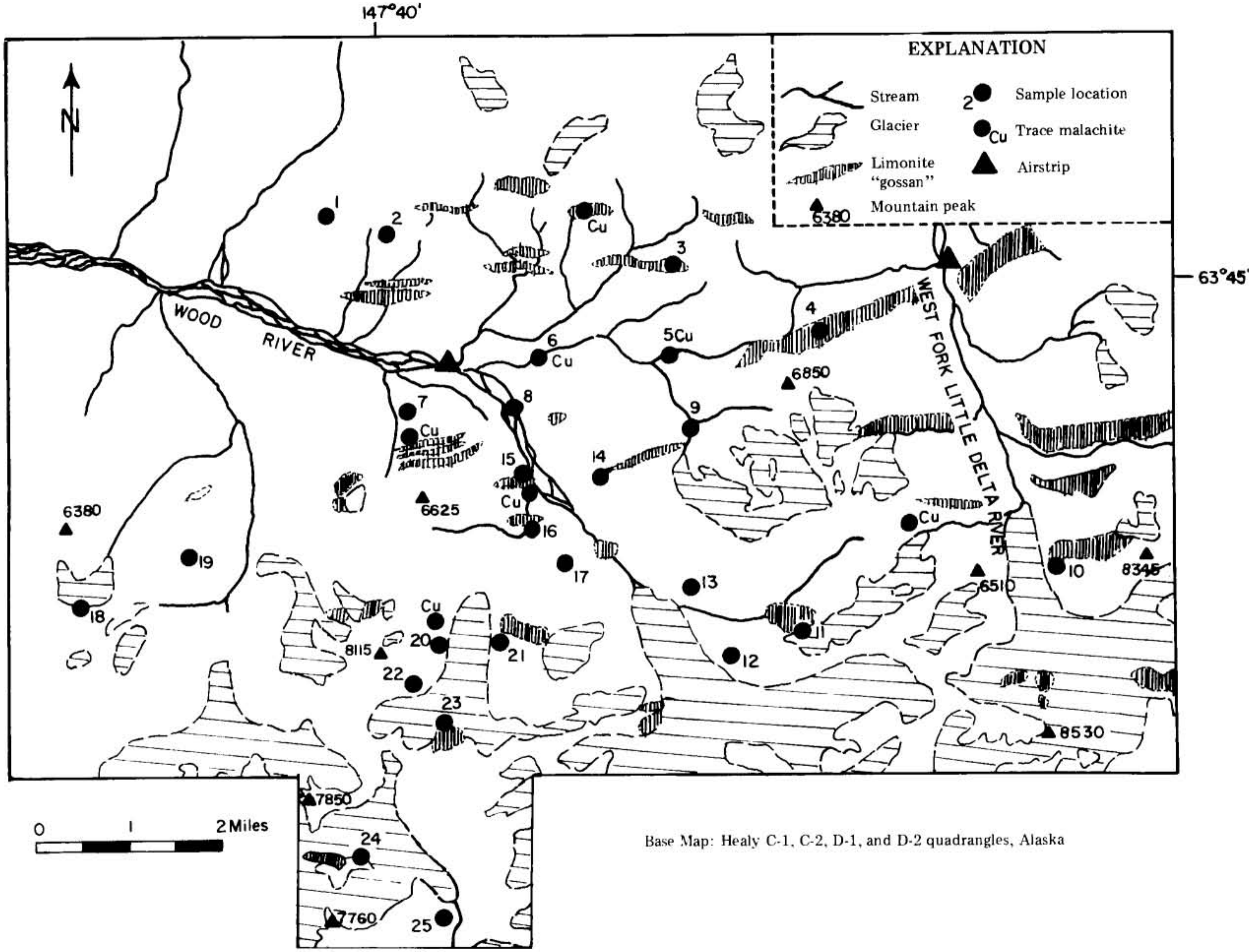


Figure 4. Regional aeromagnetic survey of the northeast part of the Healy 1:250,000 quadrangle.



Base Map: Healy C-1, C-2, D-1, and D-2 quadrangles, Alaska

Figure 5. Geochemical samples, locations, upper Wood River area.

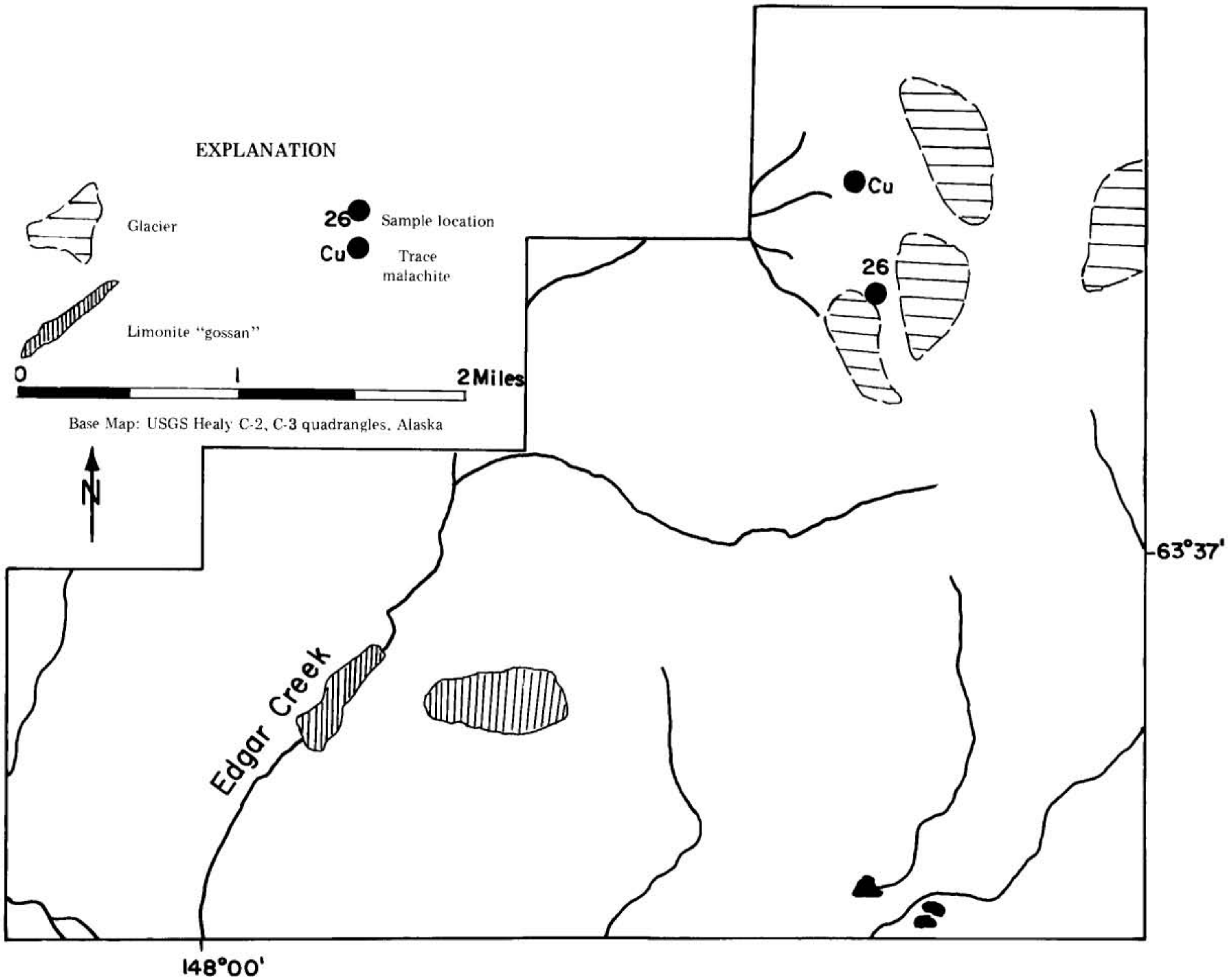


Figure 6. Geochemical samples, locations, Edgar Creek area.

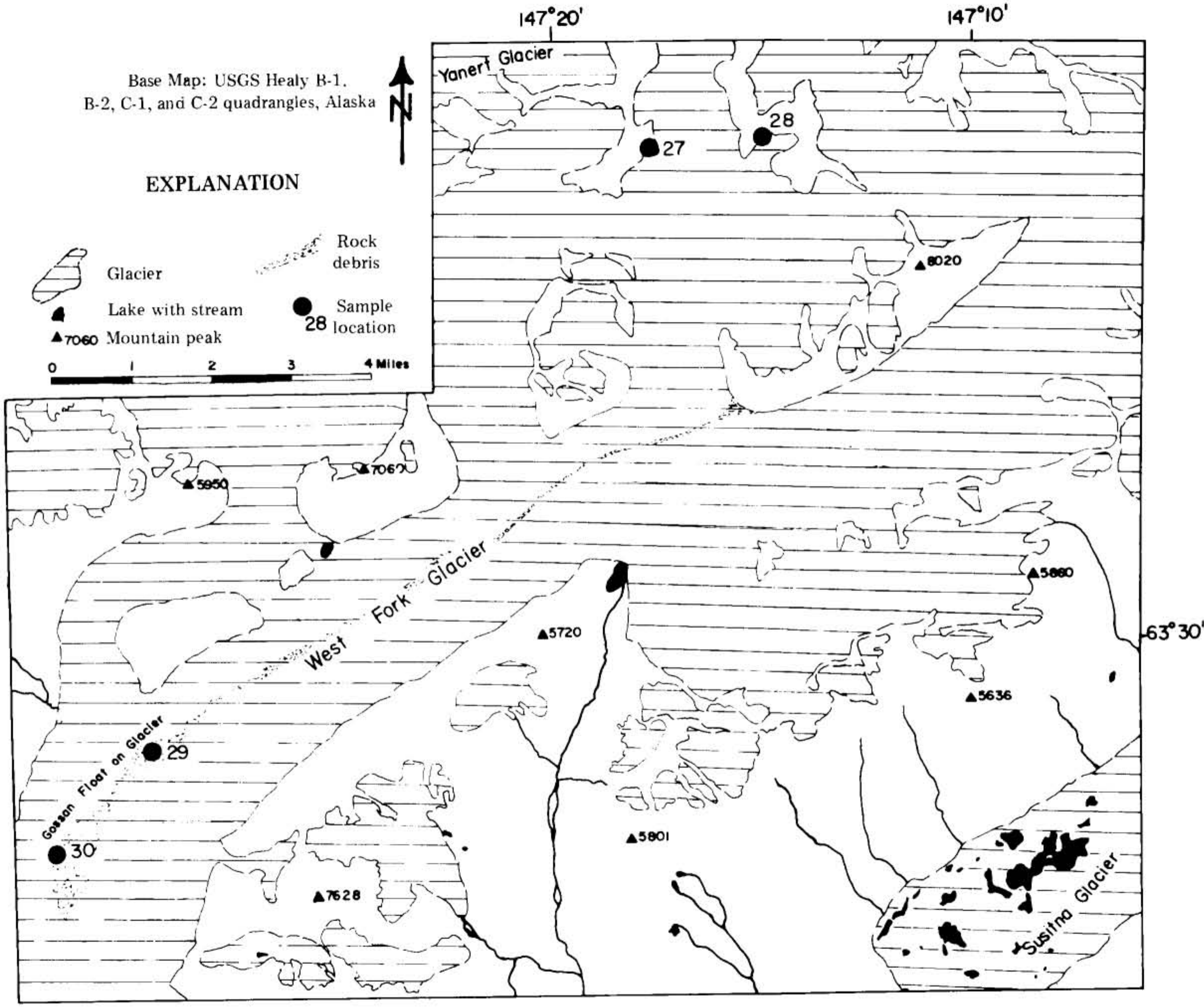


Figure 7. Geochemical samples, locations, West Fork glacier area.

Hickman, R.G., 1974, Structural geology and stratigraphy along a segment of the Denali Fault System, central Alaska Range, Alaska: Ph. D. thesis, Univ. of Wisconsin, 276 p.

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Table 1. *Atomic absorption spectrophotometric analyses of grab samples from the upper Wood River, Edgar Creek, and West Fork Glacier areas*[1]

Map	Field	Cu	Pb	Zn	Ag	Au	Ni	Remarks
1	UW 1574/30	34	11	91	0.2	ND[2]	135	
2	UW 1574/31	16	8	104	0.2	ND	132	Birch Creek Schist-stained zone
3	WR5	17	11	66	0.2	0.5	113	Gossan in Birch Creek Schist
4	K469	69	13	44	2.2	ND	67	Gossan in contact zone, granodiorite
5	73AST 1583	202	14	42	0.4	1.0	84	Heavy gossan stain in gabbro; malachite in fractures of sediments
6	73AST 1581	193	65	78	0.2	ND	20	Sulfide-bearing mafic rock
7	73AST 1580	172	28	132	ND	0.7	32	Iron-stained, sulfide-bearing gabbro with pyritic sediments
8	73AST 582a	700	18	29	0.3	0.7	6	Sulfide-bearing float in flood plain
9	73AST 1582	188	8	76	0.4	ND	20	Grab sample of pyritized sediments and ultramafic(?) igneous rock
10	K563a	833	12	25	1.2	0.2	228	Gossan zone near gabbro sill, 3 samples, composite
	K563b	259	2	65	2.5	ND	408	---------- do ----------
	K563c	13	4	270	0.4	0.5	192	---------- do ----------
11	WR110	72	28	125	0.9	ND	ND	Gossan zone near gabbro sill
12	WR115	100	8	82	ND	ND	20	Gabbro sill
13	73AST 583a	---[3]	16	20	0.5	ND	10	Gossan in Paleozoic metasediments (Pc)
	73AST 583b	750	8	50	1.0	ND	14	---------- do ----------
14	73AST 1579	30	18	7	1.0	0.2	13	Iron-stained silicified sediments and gabbro grab sample
15	73AST 582b	460	17	24	0.7	ND	6	Sulfide-bearing float in creek, gabbro
16	73AST 1577	36	44	12	1.0	0.5	13	Hydrothermally altered zone, conspicuous mineral staining
17	73AST 1578	84	9	47	0.2	ND	28	Pyritized sediments near unaltered(?) gabbro
18	K426C	45	10	62	0.5	ND	43	Near iron-stained gabbro in metasediments (Om)
19	UW 1574/33	1700	5	104	0.5	ND	70	In gabbro-sediment contact zone (ga, Om)
20	73AST 584b	274	8	55	0.5	ND	17	Silicified sample in gabbro contact
21	73AST 593-3	346	31	62	0.6	ND	42	Gabbro gossan zone
22	73AST 585gb	750	9	54	2.4	ND	96	Sulfide-bearing metasediments, gabbro; chalcopyrite visible
23	K380	153	10	152	1.0	0.4	78	Gossan zone near gabbro sill
24	73AST 1584	2300	38	142	1.1	0.5	32	Massive sulfide-bearing metasediments, huge boulders with predominantly iron sulfides
25	73AST 587	190	40	186	0.4	0.5	270	Pyroxenite intrusive sample

[1] Values are in parts per million.
[2] Looked for but not detected.
[3] Not analyzed.

Table 1. *Atomic absorption spectrophotometric analyses of grab samples from the upper Wood River, Edgar Creek, and West Fork Glacier areas*[1]—Continued

Map	Field	Cu	Pb	Zn	Ag	Au	Ni	Remarks
26	K185	4700	4	41	ND	0.4	24	Gossan zone in (Pc) near gabbro sill
27	73AST 588	980	10	64	1.0	0.2	51	Gossanized gabbro and metasediments
28	73AST 589	92	14	141	1.0	ND	56	Gossanized metasediments
29	73AST 293a	205	10	71	0.3	0.4	30	Gossan of mafic intrusive(?), West Fork moraine heavily impregnated with sulfides
30	73AST 293b	1100	65	136	1.1	ND	37	------------- do ---------------

Table 2. *Semiquantitative emission spectrographic analyses of samples from the upper Wood River, Edgar Creek, and West Fork Glacier areas, Alaska*[1]

Map	Fe (%)	Co (ppm)	Cr (ppm)	Mn (ppm)	V (ppm)	Zr (ppm)	B (ppm)	Ba (ppm)	Be (ppm)	Nb (ppm)	Sc (ppm)	Sr (ppm)	Y (ppm)	Ca (%)	Mg (%)	Ti (%)
1	7.0	30	100	5000	150	20	10	700	ND[2]	10	ND	1500	20	7.0	0.7	0.02
2	5.0	ND	300	5000	150	ND	300	1000	ND	10	ND	200	ND	2.0	0.4	0.01
3	5.0	30	200	5000	150	20	30	2000	ND	10	ND	200	ND	3.0	0.3	0.01
4	4.0	10	500	1500	150	200	20	2000	5	10	20	500	50	7.0	5.0	0.5
5	5.0	30	200	1000	200	150	20	5000	3	10	30	500	30	5.0	5.0	0.7
6	7.0	50	100	1000	200	150	10	3000	2	10	50	500	30	7.0	5.0	0.6
7	10.0	30	200	1500	200	200	10	1000	3	10	30	300	20	5.0	5.0	0.7
8	7.0	50	200	1000	70	200	20	1000	2	10	10	200	30	1.5	0.3	0.5
9	- - - -[3]	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
10a	10.0	30	150	5000	700	ND	20	1000	ND	10	ND	100	ND	1.0	0.2	0.03
10b	15.0	50	50	5000	100	ND	20	1500	ND	10	ND	100	ND	0.1	0.4	0.05
10c	5.0	30	200	5000	150	50	10	100	ND	10	ND	100	30	0.7	0.3	0.05
11	3.0	20	150	500	150	200	50	2000	10	10	20	200	20	1.0	4.0	0.5
12	10.0	50	200	1500	500	50	10	500	ND	10	30	300	10	7 0	5.0	1.0
13a	5.0	10	100	700	100	150	20	5000	3	10	20	200	10	3.0	2.0	0.7
13b	10.0	30	150	1000	150	300	20	1500	5	10	50	300	70	5.0	2.0	1.0
14	2.0	ND	150	300	100	70	ND	1500	5	10	ND	200	ND	2.0	0.7	0.2
15	10.0	30	150	700	100	150	20	1000	2	10	10	200	30	1.0	1.5	0.5
16	2.0	ND	100	300	100	100	20	1000	3	10	ND	100	ND	0.3	0.5	0.2
17	7.0	30	200	1000	100	100	10	5000	ND	10	20	300	10	7.0	4.0	5.0
18	7.0	ND	50	5000	150	50	10	1000	2	10	ND	1500	20	7.0	1.5	0.05
19	12.0	50	50	1500	100	ND	20	50	ND	10	ND	300	ND	5.0	5.0	0.02
20	5.0	30	150	700	100	100	10	5000	2	10	10	200	ND	4.0	3.0	0.5
21	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
22	12.0	50	200	5000	100	ND	20	1000	ND	10	ND	100	ND	0.5	0.3	0.05
23	15.0	10	150	3000	200	20	20	1000	2	10	ND	100	ND	3.0	5.0	0.05
24	12.0	100	200	1500	100	70	20	200	2	10	ND	100	ND	4.0	2.0	0.1
25	5.0	20	200	500	500	70	20	1500	7	10	ND	100	ND	1.5	0.7	0.2
26	2.0	10	150	1000	100	50	20	1000	3	10	ND	100	ND	0.1	0.1	0.2
27	7.0	50	300	1500	150	100	20	5000	5	10	10	200	20	7.0	4.0	0.3
28	4.0	20	200	500	150	200	20	1500	5	10	10	200	20	3.0	4.0	0.6
29	7.0	30	70	1500	400	50	10	700	ND	10	20	300	ND	5.0	5.0	0.7
30	10.0	50	150	1000	500	100	10	1000	ND	10	30	300	20	7.0	4.0	0.5

[1] Sb, Mo, W, Cd, As, Bi, Sn, and La were looked for but not detected.
[2] Looked for but not detected.
[3] - - means not analyzed.