Geology and Mineralogy

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RECONNAISSANCE FOR RADIOACTIVE DEPOSITS IN THE HYDER DISTRICT, SOUTHEASTERN ALASKA, 1949*

By

Walter S. West and Paul D. Benson

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Trace Elements Investigations Report 73

* This report concerns work done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

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RECONNAISSANCE FOR RADIOACTIVE DEPOSITS IN THE HYDER DISTRICT, SOUTHEASTERN ALASKA, 1949

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ABSTRACT

Radioactivity reconnaissance during 1949 in the Hyder district, southeastern Alaska, revealed that radioactive material is widely distributed on the Mountain View mining property. However, no uranium deposits of commercial value were found in the restricted parts of the district covered by this investigation.

Anomalous radioactivity was detected at a number of localities on the Mountain View property, but the source could not be determined at all sites. The most highly radioactive unconcentrated vein sample collected in 1949 contained 0.049 percent equivalent uranium, and the most intensely radioactive vein-material concentrate (specific gravity greater than 2.89) contained 0.398 percent equivalent uranium. Both samples are from the Skookum tunnel on the Mountain View property.

The radioactive material on the properties investigated in the Hyder district appears to be chiefly uranium which occurs in an unidentified, highly radioactive, opaque mineral and, also, in trace amounts in the sulfides of the vein deposits. Some of the radioactive material, however, occurs as disseminated deposits in the igneous rocks of the district and, also, to a minor extent as thin secondary coatings on fracture surfaces in veins and rocks.

INTRODUCTION

Location and accessibility

The Hyder district of southeastern Alaska is situated near the head of the Portland Canal and comprises the area drained by the Salmon River (fig. 1). Its limits are defined on the north and east by the international boundary; on the west by the divide between the headwaters of the streams tributary to the Salmon River and those tributary to the Chickamin River; and on the south by the Portland Canal. The Mountain View property is located approximately 5 miles north of Hyder, centering near the junction of Skookum Creek with Fish Creek, a tributary to the Salmon River. The town of Hyder is near the mouth of the Salmon River and extends along Portland Canal to the international boundary.

Supplies for the area are obtained from Hyder, and from Stewart, B. C., which is located two miles northeast of Hyder at the head of the Portland Canal. These towns are accessible the year round by both float-plane and boat transportation.

Many of the mining properties in the district are accessible from Hyder and Stewart by roads and trails (fig. 1). A good gravel road between Hyder and the Premier mine in Canada affords access to some of the mineral deposits east of the Salmon River. About 11 miles of this road is in Alaska. Another narrow road has been constructed along the West Fork of Texas Creek for a distance of about 10 miles from the bridge across Salmon River above Ninemile, where it connects with the main highway, to the vicinity of Texas Lake at the head of the West Fork valley. Some of the properties not accessible by road may be reached by pack trails built and maintained by the U. S. Forest Service.

Purpose and scope of the investigation

Early in the summer of 1949, Howard M. Fowler, a mining engineer of the Territorial Department of Mines, made a brief radioactivity investigation on the Mountain View property. Significant radioactivity anomalies were detected, but the source material could not be determined. A Geological Survey party, based in southeastern Alaska during the summer of 1949 for the purpose of investigating leads to uranium prospects, then made additional studies in an effort to determine the source of the radioactivity and to attempt to locate and study other possible radioactive deposits in the area. The field party, consisting of Walter S. West and Paul D. Benson, geologists, and Arthur E. Nessett, camp assistant, spent several weeks in August and September, 1949, in the Hyder district. In addition to surface and underground radioactivity investigations on the Mountain View property, brief reconnaissance examinations were made of several other properties and along most of the roads and some of the trails in the district. This work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

Supplemental to sampling done by the Geological Survey, Mr. Arthur O. Moa, manager of the Mountain View Gold Mining Company property, by request kindly submitted additional samples from various radioactive veins he had located on the property.

GEOGRAPHY

The Hyder district is a mountainous region exhibiting great relief. The valley floors of Salmon River and Texas Creek, which represent the only relatively level land in the district, rise from sea level to about 500 feet, and the mountains extend steeply upward to heights between 4,000 and 6,000 feet. The area in general is heavily forested up to 3,000 to 4,000 feet above sea level. The timber, mainly western and black hemlock

and Sitka spruce, is of sufficient quantity and quality to supply local mining needs. Within this forested zone thick underbrush constitutes a hindrance to exploration in many places. From the timber line up to the lower limit of the snow and ice fields is a zone of alternating bare rock, talus, and glacial debris covered in part by heather, scrawny trees, and patches of snow. Snow and ice caps cover all large areas above 5,000 feet, and glaciers are found in protected basins and valleys at much lower altitudes. The major streams in the area are glacial streams, although on some of the properties there are clear mountain streams.

The area is subject to extremely heavy snowfalls, and, because of this fact, prospecting and development have been seriously retarded. The heaviest precipitation occurs in the late fall and winter months, mostly in the form of snow, with an average annual snowfall of about 18 feet in the lowest areas but occasionally amounting to as much as 40 to 60 feet at higher altitudes. The summer season is relatively short. Properties that lie at the higher altitudes rarely have more than four to five months of open season, whereas those, such as the Mountain View, lying at altitudes of less than 1,500 feet above sea level are favored with an open season of from seven to eight months during the year. The rainfall is moderately heavy during late spring, summer, and early fall, being least in May and June and greatest in July, August, September, and October. The mean annual temperature at sea level is 40 degrees Fahrenheit, and the winter temperatures rarely fall below zero.

GEOLOGY

The geology and ore deposits of the Hyder district have been described by Brooks (1902), Wright and Wright (1908), Chapin (1916), Mertie (1921), Westgate (1921),

Buddington (1925 and 1929), Jewell (1927), Buddington and Chapin (1929), and Erickson (1946). The bulk of the geology of the Hyder district as described below is taken from Buddington (1929).

The district lies adjacent to and includes a portion of the northeastern border of the Coast Range batholith, which parallels the shore line of British Columbia and southeastern Alaska for approximately 1,100 miles and ranges from 20 to 110 miles in width. The batholith at the latitude of Hyder is about 50 miles wide and the outlying dikes, stills, and stocks genetically related to the batholith further increase the width affected by the intrusives to over 100 miles. Mineral deposits are widespread in this border belt, which is generally referred to as the eastern or interior belt of mineralization.

The four major rock units (fig. 1) distinguished in the Hyder district are as follows:

1) Hazelton group: A sequence of bedded rocks which are both volcanic and sedimentary in origin and consist of greenstone, tuff, volcanic breccia, graywacke, slate, argillite, quartzite, and rarely limestone.

2) Texas Creek granodiorite: A central batholithic mass of gray granodiorite which is bounded on the east and west by and is intrusive into the Hazelton group.

3) Hyder quartz monzonite: A batholith of pinkish quartz monzonite which lies along the southern border of and is intrusive into the Hazelton group and the Texas Creek granodiorite.

4) Boundary granodiorite: A pink granodiorite stock lying on the north side of and intrusive into the Hazelton group and the Texas Creek granodiorite.

The Hazelton group is considered to be Jurassic(?) in age, and the Texas Creek, Hyder, and Boundary granitic rocks, all of which are facies of the Coast Range batholith, are probably of Jurassic or Cretaceous age. Small stocks and dikes of gray, sheared

porphyry, genetically related to the Texas Creek granodiorite, cut the sedimentary and volcanic rocks of the Hazelton group. Both the Texas Creek granodiorite and the rocks of the Hazelton group are also intruded at numerous places by dikes of pink and white granodiorite or dark diorite porphyry which are allied genetically with the Hyder quartz monzonite and the Boundary granodiorite. All four major groups of rocks and the associated dikes and stocks are cut by narrow lamprophyre dikes. Aplite dikes are also found in all four groups of rocks. Fluvial, glaciofluvial, and glacial debris of Recent age has been deposited along the flood plains of the main streams, on benches along the stream valleys, in some of the tributary valleys, and on the less steep mountain slopes.

The rocks of the Hazelton group and the Texas Creek granodiorite have been subjected to a considerable amount of minor faulting, but no fault of any great magnitude has been observed. Although joints have been developed in the Texas Creek granodiorite, there appears to be no constancy in the direction of their strike or dip except locally. A more definitely defined joint system occurs in the Hyder monzonite.

Only the Texas Creek batholith with its associated outlying stocks and dikes, and the rocks of the Hazelton group are known to contain mineral deposits of economic importance. Some of the mineral veins, which occur along or near the contact between the above mentioned rock groups, are cut by granodiorite and diorite porphyry dikes that are associated with the Hyder quartz monzonite and the Boundary granodiorite as well as by still younger lamprophyre dikes.

The only mining activity in the Hyder district during 1949 was at the Riverside mine.

GEOLOGY AND DEVELOPMENT OF THE MOUNTAIN VIEW PROPERTY

The eastern contact between the Texas Creek granodiorite and the rocks of the Hazelton group extends approximately through the middle of the Mountain View property and strikes a little east of north (fig. 2). The following data on geology and development of the property have been extracted principally from Buddington (1929) and from an unpublished report prepared in 1928 for the Mountain View Gold Mining Company by J. E. Kania and kindly made available to the authors by Mr. Moa.

Rock outcrops are not numerous as the property is covered by a layer of glacial till, decomposed rock, and vegetation. The youngest known igneous rocks on this property are a series of fine-grained lamprophyre dikes of moderate widths (fig. 3). They strike either northeast or northwest with dips consistently to the west. Preceeding the injection of these mafic dikes was the intrusion of at least one quartz porphyry dike believed to be genetically related to the Hyder quartz monzonite. Prior to this was a period during which a few aplite dikes, thick barren quartz veins, and large rather siliceous granodiorite dikes and stocks were injected as the acid end products of the batholithic invasion of the Texas Creek granodiorite into the already cooled periphery of the batholith and into the rocks of the Hazelton group. The Hazelton group on the Mountain View property is composed chiefly of volcanic rocks.

The period of primary mineralization is believed to have followed closely upon the intrusion of the Texas Creek batholith and its associated dikes and stocks, although there is a possibility that part of the mineral veins were formed prior to the invasion of some of the dikes. The ore bodies are cut by the lamprophyre dikes, as well as by numerous fractures and minor faults, as evidenced in the Skookum tunnel and in the surface strippings of the Gray Copper vein.

The primary mineral deposits were formed at considerable depths beneath the surface and are represented by veins belonging to the high- and intermediate-temperature types and by combinations of both. Secondary minerals have been deposited by circulating meteoric waters.

Some of the mineralized veins on the property have been traced for distances of several hundred feet on the surface, principally by trenching, and for corresponding distances in depth by drifts. For example, the Gray Copper vein has been traced in artificial surface exposures for a distance of 460 feet along its strike; underground drifting (stations 24 - 29W, fig. 3) in the Skookum tunnel has exposed this vein for a distance of 315 feet with the distance up the dip between this drift and the surface outcrop being 360 feet. The Gray Copper vein pinches and swells, and is probably more or less typical of most of the other veins on the property in physical characteristics. The pinched segments are shattered, contain thin traces of gouge, and are sparsely mineralized, whereas the wider parts of the vein display only slight shattering, no gouge, and are generally well mineralized.

The most extensive underground development on the property is the Skookum tunnel, consisting of over 4,200 linear feet of drifting and crosscutting (fig. 3). Cross sections of the drifts and crosscuts in this tunnel range from 5 by 7 feet to 9 by 9 feet. The roofs and walls throughout the tunnel stand without timbering. Water seepage presents no problem because of a gravity drain. In 1949 the tunnel was equipped with mine track (12 pound rail), two ore cars, and one flat car. In addition to the Skookum tunnel, several other smaller drifts and numerous open cuts have been made on the property. The one shaft that has been sunk on the Gray Copper vein is almost filled with water and is inaccessible for study.

RADIOACTIVITY INVESTIGATIONS

Field methods

The instruments used for field radioactivity studies in the Hyder district were standard commercial models of portable survey meters modified to accept probes consisting of 6-inch beta-gamma tubes or a gang of four 1- by 18-inch brass-walled gamma tubes connected in parallel. For radioactivity traverses on foot, the survey meters equipped with the gamma probes were mounted on packboards; for spot checking outcrops, underground workings, ore dumps, talus blocks, veins, dikes, and rock and mineral specimens 6-inch beta-gamma probes were used in place of the large gamma probes.

Surface traverses were made along the Salmon River and Texas Lake roads from Hyder to Texas Lake; along the Mountain View and Titan trails; and over parts of the Mountain View, Ambrose, Adanac, Titan, Sixmile, and Riverside claims (fig. 1). Subsurface traverses were made in the Sixmile, Titan, and Skookum tunnels and in the Riverside mine as well as in several other drifts on the Mountain View property. In addition 43 rock samples collected in 1949 by Mr. William H. Kerns, U. S. Bureau of Mines, on the Mountain View, Ambrose, Last Shot, Howard, Sixmile, Hobo, Daly-Alaska, Stoner, and Liberty claims were scanned for radioactivity with a portable survey meter.

During the course of the investigation, 72 rock and mineral samples, 2 slope wash samples, 13 stream sand and gravel samples, one mill-shipping concentrate, and one mine-water sample were collected. Many of the rock and mineral samples obtained in the Skookum tunnel and from various open cuts and outcrops on the Mountain View

property were crushed in a portable lever-action jaw crusher and a hand-operated wheel-type jaw crusher on the property. A large part of each crushed sample was screened and partially concentrated by panning to reduce the size and weight of the sample and to concentrate the heavy minerals. This concentrate was saved for later studies in the Survey's Washington laboratory. The locations of the Hyder area samples which were collected beyond the limits of the Mountain View property are shown on figure 1. The locations of the surface samples from the Mountain View property are given on figure 2. Figure 3 shows the locations of the underground samples from the Mountain View property.

Laboratory methods

Selected rock and lode samples were crushed and screened in the laboratory. Measurement of the equivalent-uranium content of the minus 20- plus 150-mesh size material of each sample was made with a standard commercial model of a laboratory beta counter. These samples were then treated with bromoform to float off the minerals with a specific gravity of less than 2.89, and the heavy residues were analyzed for radioactivity. The analyses for equivalent-uranium content of the samples were made principally by Arthur E. Nelson and Paul D. Benson of the Geological Survey at Washington, D. C. The percent equivalent uranium for each sample is given in table 1.

In order to expedite microscopic, X-ray, spectrographic, and chemical analyses, the heavier-than-bromoform mineral fractions of certain samples were further concentrated with methylene iodide (specific gravity 3.3) and separated into magnetic and nonmagnetic subfractions with an isodynamic separator. Mineralogic determinations

Table 1.--Equivalent-uranium content and uranium-bearing minerals of samples from the Mountain View property and other parts of the Hyder district, southeastern Alaska, 1949

(The parts of the concentrates analyzed for equivalent uranium were the heavy-mineral fractions with specific gravity greater than 2.89. The presence of uranium in the minerals listed as uranium-bearing was determined qualitatively by sodium-fluoride flux tests in the Washington laboratories of the Geological Survey.)

Sample No.	Location	Type of sample	Concentration ratio	Percent equivalent uranium Raw sample	Percent equivalent uranium Concentrate	Uranium-bearing minerals
3336	Floor of first tunnel north of Fourmile along Salmon River road on the Sixmile claim	Waste rock ----	40:1	--	0.007	Hematite and limonite.
3337	Second stream north of Fourmile along Salmon River road	Sand and gravel	--	--	.002	--
3338	First stream north of Riverside mine along Salmon River road	-----do------	--	--	.002	--
3339	Fish Creek, just above road bridge at Fourmile	-----do------	260:1	--	.002	--
3341	Salmon River, about 1 mile north of Hyder	-----do------	--	--	.007	Zircon.
3342	Hyder quartz monzonite about 2 miles north of Hyder along road	Slopewash ----	240:1	--	.002	--
3343	First stream north of Hyder along Salmon River road	Sand and gravel	300:1	--	.01	Sphene.
3344	Floor of first right side cut from portal in Skookum tunnel	Waste rock ---	110:1	--	.002	--
3345	Floor of second right side cut from portal in Skookum tunnel	-----do------	135:1	--	.001	--
3346	Floor of third right side cut from portal in Skookum tunnel	-----do------	55:1	--	.002	--
3347	Floor of fourth side cut from portal in Skookum tunnel	-----do------	60:1	--	.004	--
3348	Floor of fifth and sixth side cuts from portal in Skookum tunnel	-----do------	55:1	--	.002	--
3349	Floor of seventh side cut from portal in Skookum tunnel	-----do------	500:1	--	.002	--
3350	Floor of eighth side cut from portal in Skookum tunnel	-----do------	1440:1	--	.007	--
3351	Floor of ninth side cut from portal in Skookum tunnel	-----do------	120:1	--	.002	--
3352	Floor of Skookum tunnel at Station 12	-----do------	90:1	--	.005	--
3353	Floor of tenth side cut near Station 18 in Skookum tunnel	-----do------	50:1	--	.003	--
3354	Floor of Skookum tunnel at and 12 feet in both directions along the right wall from Station 20	-----do------	45:1	--	.014	--
3355	Floor of Skookum tunnel at and near Station 22	-----do------	90:1	--	.009	--
3356	Wall of side cut near Station 24 in Skookum tunnel	Wall rock ----	270:1	--	.006	--
3357	Floor of side cut near Station 24 in Skookum tunnel	Waste rock ---	80:1	--	.042	Molybdenite, pyrite (with hematitic coating), pyrrhotite, scheelite, and an unidentified black cubic mineral.
3358	Floor of side cut near Station 24 in Skookum Tunnel	-----do------	260:1	--	.012	Molybdenite, pyrite (with hematitic coating), pyrrhotite, and an unidentified black cubic mineral.
3359	Floor of side cut near Station 24 in Skookum tunnel	-----do------	150:1	--	.019	Molybdenite, pyrite (with hematitic coating), pyrrhotite, and an unidentified black cubic mineral.
3360	Floor in end extension of Skookum tunnel beyond Station 24	-----do------	100:1	--	.006	--

Table 1.--Equivalent-uranium content and uranium-bearing minerals of samples from the Mountain View property and other parts of the Hyder district, southeastern Alaska, 1949--Continued

Sample No.	Location	Type of sample	Concentration ratio	Percent equivalent uranium Raw sample	Percent equivalent uranium Concentrate	Uranium-bearing minerals
3361	Floor near end of long left side cut near Station 29 in Skookum tunnel	Waste rock ---	25:1	--	0.003	--
3362	Floor of Skookum tunnel along base of right wall between Stations 51 and 52 and in left side cut at Station 52	-----do------	140:1	--	.008	--
3363	Floor of right side cut near Station 54 in Skookum tunnel	-----do------	390:1	--	.040	Molybdenite.
3364	Floor of left side cut at Station 58 in Skookum tunnel	-----do------	400:1	--	.029	Molybdenite.
3365	Floor of right side cut at Station 61 in Skookum tunnel	-----do------	50:1	--	.001	--
3366	Floor of left side cut at Station 62 in Skookum tunnel	-----do------	50:1	--	.003	--
3367	Floor of Skookum tunnel along right wall at Station 64	-----do------	30:1	--	.001	--
3368	Floor near termination of Skookum tunnel beyond Station 65	-----do------	50:1	--	.002	--
3369	Walls at and 15 feet in both directions from Station 12 in Skookum tunnel	Wall rock ----	100:1	--	.003	--
3370	Skookum Creek, 40 yards above portal of Skookum tunnel	Sand and gravel	--	--	.002	--
3371	Fish Creek, just below Mountain View powerhouse	-----do------	150:1	--	.001	--
3372	Adanac Creek, 15 yards below Mountain View trail bridge	-----do------	--	--	.002	--
3373	First major tributary to Fish Creek below Adanac Creek	-----do------	--	--	.001	--
3374	Third tributary to Fish Creek below Adanac Creek	-----do------	--	--	.001	--
3375	Fourth tributary to Fish Creek below Adanac Creek	-----do------	--	--	.001	--
3376	Floor of Gray Copper vein prospect tunnel, Mountain View property	Waste rock ---	12:1	--	.001	--
3377	First small tributary to Fish Creek below Adanac Creek	Sand and gravel	220:1	--	.001	--
3378	Fifth tributary to Fish Creek below Adanac Creek	-----do------	--	--	.003	--
3379	Rock dust removed from the walls of Skookum tunnel at and a short distance both directions from Station 12	Rock dust-----	55:1	--	.006	Molybdenite, and pyrite (with hematitic coating).
3380	Riverside mine	Mill concentrate	--	--	.001	--
3381	Wall of Skookum tunnel at Station 6	Wall rock ----	190:1	0.003	.044	--
3382	Gray Copper vein in Skookum tunnel between Stations 26W and 27W	Vein---------	14:1	--	.001	--
3383	Wall of Skookum tunnel at Station 8	Wall rock ----	45:1	--	.006	--
3384	Wall of Skookum tunnel from Station 17 to 17-1/2 (3 locations)	-----do------	75:1	--	.003	--
3385	Wall of Skookum tunnel from Station 14-1/2 to 15 (2 locations)	-----do------	55:1	--	.002	--
3386	Wall of Skookum tunnel between Station 51-1/2 and Station 52	-----do------	100:1	.004	.015	Molybdenite and pyrite.
3387	Wall of Skookum tunnel between Station 55 and Station 56	-----do------	120:1	.006	.034	Molybdenite, galena, and pyrite.
3388	Wall of Skookum tunnel at Station 58-1/2	-----do------	280:1	--	.023	Galena, molybdenite, pyrite, and sphalerite.

Table 1.--Equivalent-uranium content and uranium-bearing minerals of samples from the Mountain View property and other parts of the Hyder district, southeastern Alaska, 1949--Continued

Sample No.	Location	Type of sample	Concentration ratio	Percent equivalent uranium Raw sample	Percent equivalent uranium Concentrate	Uranium-bearing minerals
3389	Wall of Skookum tunnel at Station 60	Wall rock ----	250:1	0.005	0.015	Biotite, galena, molybdenite, and pyrite.
3390	Floor of south drift on Sixmile claim along Salmon River road	Waste rock ---	50:1	--	.003	--
3392	Lode in right wall of Skookum tunnel about 4 feet from end of right side cut at Station 24 and breast high	Vein material	12:1	.028	.245	Molybdenite, pyrite, pyrrhotite, and an unidentified black cubic mineral.
3393	Right wall of Skookum tunnel about 4 feet from end of right side cut at Station 24	Wall rock and vein material	20:1	.012	.059	Molybdenite, pyrite, pyrrhotite, and an unidentified black cubic mineral.
3394	Right wall of Skookum tunnel between Stations 55 and 56	Vein material	4:1	.049	.089	Molybdenite.
3395	Lode material on floor of Skookum tunnel in right side cut at Station 24	-----do------	3:1	.035	.071	--
3396	Right wall of Skookum tunnel at Station 58-1/2	Vein material and wall rock	60:1	.016	.398	Pyrrhotite.
3732	Between Gold vein tunnel and "Blue Gouge" cut on Mountain View property	Rock---------	40:1	.004	.005	Galena, pyrite, and sphalerite.
3733	"Blue Gouge" cut, 75 feet north of Gold vein tunnel on Mountain View property	-----do------	540:1	--	.005	--
3734	"Blue Gouge" cut, 7 feet south of sample 3733	Vein material	2:1	.001	.001	--
3735	West end of cut on Marsh vein, Mountain View property	-----do------	25:1	--	.003	--
3736	Marsh vein cut, 5 feet east of sample 3735	Rock---------	970:1	--	.051	Biotite, hematite, molybdenite and pyrite.
3737	Marsh vein, Mountain View property	Vein material	1:1	.001	--	--
3738	Near Marsh vein	Dike---------	1100:1	--	.032	Galena, hematite, limonite, pyrite, and chalcopyrite.
3739	Outcrop about 100 feet north of sample 3738 on Mountain View property	-----do------	180:1	--	.137	Hematite and limonite.
3740	Hanging wall of Canyon vein on south side of Fish Creek and about 1000 feet south of Skookum tunnel portal	Rock and vein material------	210:1	--	.258	Biotite, galena, molybdenite, pyrite, and sphalerite.
3741	Hanging wall of Canyon vein on south side of Fish Creek	Rock---------	320:1	--	.042	--
3742	Canyon vein on south side of Fish Creek	-----do------	25:1	.009	.049	Biotite, molybdenite, and pyrite.
3743	West side of upper tunnel on Silver Falls vein, footwall side of vein, and about 2000 feet south of Skookum tunnel portal	-----do------	14:1	--	.002	--
3744	Silver Falls vein, near sample 3743	-----do------	5:1	.007	.007	--
3745	Bluff about 100 feet south of sample 3743	-----do------	270:1	--	.006	--
3746	Slide vein, east of Fish Creek and the Silver Falls vein	-----do------	1450:1	--	.032	--
3747	Slide vein, near sample 3746	-----do------	140:1	.005	.025	--
3748	Discovery outcrop on Morning Claim, about 3300 feet south of Skookum tunnel portal	-----do------	30:1	--	.002	--
3749	Two inch stringer near Canyon vein on east side of Fish Creek	Vein material	4:1	.002	.006	--
3750	Footwall side of Canyon vein	Rock---------	350:1	--	.012	--
3751	Footwall side of Canyon vein	-----do------	230:1	.004	.039	Chlorite, marcasite, and sericite.

Table 1.--Equivalent-uranium content and uranium-bearing minerals of samples from the Mountain View property and other parts of the Hyder district, southeastern Alaska, 1949--Continued

Sample No.	Location	Type of sample	Concentration ratio	Percent equivalent uranium Raw sample	Percent equivalent uranium Concentrate	Uranium-bearing minerals
3752	Westerly open cut on Ruby Silver vein, Mountain View property	Rock---------	45:1	--	0.001	--
3753	Ruby Silver vein	Rock and vein material------	90:1	--	.005	--
3754	Bluff just above upper tunnel on Ruby Silver vein	Rock---------	450:1	--	.019	Molybdenite, pyrite, and marcasite.
3755	Cliff about 75 feet north of upper tunnel on Ruby Silver vein	-----do------	100:1	--	.012	Hematite, limonite, magnetite, pyrrhatite, and molybdenite.
3756	Canyon vein, Mountain View property	Rock and vein material------	110:1	--	.003	--
3757	Rampart vein, west of Canyon vein on the Mountain View property	-----do------	45:1	--	.002	--
3758	Cliff vein, about 100 feet south and a little west of sample 3757	-----do------	100:1	--	.002	--
3759	Cliff vein, Mountain View property	Rock---------	80:1	0.001	.005	Pyrite and marcasite.

of the heavier-than-bromoform mineral fractions of some samples were completed without necessitating further heavy-mineral concentration or fractionation by the above methods. All of the mineralogic, spectrographic, and chemical studies of the samples, with the exception of those done by the authors, were made by Joseph Berman, E. H. Cisney, M. H. Fletcher, Robert Meyrowitz, Kiyoko Onoda, J. N. Stich, and C. L. Waring; all are with the Geological Survey laboratories at Washington, D. C.

MINERALOGY

Time has not permitted a thorough study of the mineralogy of all the samples from the Mountain View property and other parts of the Hyder district. Sample 3396 (table 1 and fig. 3) has the most radioactive (0.398 percent equivalent uranium) heavy-mineral fraction (specific gravity greater than 2.89) of all the samples collected in the Hyder district in 1949. A mineralogic analysis of this sample by the authors shows that it contains: major amounts of pyrrhotite, rutile (with an opaque coating), molybdenite, and pyrite; and minor amounts of chlorite, prehnite, apatite, amphibole, monazite(?), carbonate minerals, and an unidentified brownish-black, isotropic mineral. In addition, the heavy-mineral fractions (specific gravity greater than 2.89) of 36 other samples were analyzed for their mineral content in the laboratories of the Geological Survey at Washington, D. C.; the samples were selected on the basis of their equivalent-uranium content or location. These mineralogic studies indicated the presence of the sulfides--bornite, chalcopyrite, galena, marcasite, molybdenite, pyrite, pyrrhotite, sphalerite, and tetrahedrite; the oxides--hematite, limonite, magnetite, and pyrolusite; also, apatite, barite, biotite, celestite, cerussite, chlorite, fluorite, gold, rutile, scheelite, sericite, sphene, wulfenite, and zircon.

As the mineral deposits in the Hyder district in some respects resemble the uraninite-bearing veins lying to the east in British Columbia (Stevenson, 1950), detailed mineralogic studies were made of the heavy-mineral fractions of samples 3357, 3392, and 3393 (table 1 and fig. 3) from the vicinity of station 24 in the Skookum tunnel on the Mountain View property in an attempt to determine whether uraninite was the cause for all or part of the radioactivity at this site. The site was selected because it is believed to be fairly representative of the several locations of anomalous radioactivity in the Skookum tunnel. The work of Cisney, Fletcher, Onoda, and Stich (unpublished laboratory report, January 24, 1950) shows that a primary uranium oxide mineral was not identified as the cause of the radioactivity in the samples studied. According to their studies, the uranium in these samples occurs in a highly radioactive, opaque, cubic mineral closely associated with rutile (TiO_2) which is present in only limited quantities. Whether the mineral occurs as intergrowths or as inclusions in the rutile is not known. Spectrographic analysis of this mineral shows that it also contains titanium, iron, and niobium. Chemical analyses of impure concentrates of the mineral, obtained largely by hand-picking under the microscope, show that it may contain as much as 7 percent uranium.

In addition to the highly radioactive cubic mineral associated with rutile, sodium-fluoride flux tests indicate that minor amounts of uranium occur, probably as an impurity, in the following minerals:

biotite	limonite	scheelite
chalcopyrite	magnetite	sericite
chlorite	marcasite	sphalerite
galena	molybdenite	sphene
hematite	pyrite	zircon
	pyrrhotite	

The uranium-bearing minerals identified in each sample are given in table 1.

Two distinct secondary uranium-bearing minerals are known to occur as thin coatings on certain weathered rock surfaces, fracture surfaces in veins, and mineralized dikes on the Mountain View property. One is a fluorescent mineral having a wide distribution but being best represented in samples 3742 and 3744 from the Canyon and Silver Falls vein respectively (table 1 and fig. 2). This mineral is very fine-grained and granular and occurs generally as crystalline aggregates. It gives a positive qualitative test for uranium and, according to K. J. Murata (oral communication), exhibits strong uranium lines through a hand spectroscope. A qualitative spectrographic analysis by Stich shows the major constituents to be calcium, aluminum, and silicon and the minor constituents to be magnesium and iron with a trace of manganese. Cisney indicates that the X-ray powder pattern of this mineral resembles that of the feldspar group, but no specific name could be assigned to this mineral. The other secondary mineral shows a positive qualitative test for uranium and appears as a thin yellow coating on fracture surfaces. It is fine-grained, nonpleochroic, and nonfluorescent under short wave ultra-violet light. It is closely associated with quartz and hydromica on the weathered rock surfaces and was found to be most abundant in sample 3732 from the vicinity of the Ruby Silver vein (table 1 and fig. 2). Sufficient material could not be separated, however, for X-ray or spectrographic analysis, and this mineral was not identified.

A sample of mine water collected from the drainage ditch in the Skookum tunnel at station 11 (fig. 3) was analyzed for uranium and other metals. The residue of the water sample was found to contain 3 parts per billion uranium when analyzed fluorimetrically by Meyrowitz. Because the sample was not acidified when taken, it is likely that the uranium content shown by this analysis is relatively low (Milkey, 1953).

A spectrographic analysis by Waring of the residue of part of the mine-water sample showed the following elements:

Mg, Ca, Na---------- over 10 percent
Fe, Si, Cu, Sr---------0.1 to 1.0 percent
Sn-----------------0.01 to 0.1 percent

A semi-quantitative spectrographic analysis by Stich of a mill concentrate from the Riverside mine (sample 3380, table 1 and fig. 1) showed the major constituents to be lead, copper, silver, iron, and silicon; cobalt, nickel, bismuth, and manganese were looked for but not found.

DISTRIBUTION OF RADIOACTIVE MATERIAL

Radioactive material has a rather widespread distribution on the Mountain View property and appears to be principally associated with sulfides in veins and veinlets. However, some of it occurs in disseminated deposits and to a minor extent in the form of thin secondary coatings on rock and vein fracture surfaces.

The largest lode occurrence of radioactive material found during the 1949 investigations, occurs in the Skookum tunnel on the right wall about breast high and four feet from the end of the right side cut at station 24 (fig. 3, sample 3392). The most highly radioactive samples collected in this tunnel were 3396 from a vein on the right wall half way between stations 58 and 59, and 3394 from a vein on the right wall between stations 55 and 56. Probably additional areas of radioactivity could be found in the Skookum tunnel by employing a more detailed study than was possible in the time allotted for this investigation and by washing the heavy coating of mine dust from the walls and ceiling wherever anomalous radioactivity is detected.

The most highly radioactive surface sample on the Mountain View property was 3740 collected by Mr. Moa from the hanging wall of the Canyon vein on the south side of Fish Creek approximately 1,000 feet south of the Skookum tunnel portal (fig. 2). Because very little time was available for studying the outcrops, not only on the Mountain View property but also along the entire extent of the Texas Creek granodiorite-Hazelton group contact in the Hyder district, there appears to be a very good possibility that radioactive deposits have a greater extent than is now known.

A highly radioactive area was encountered during the course of the investigation at station 12 and for quite a number of feet in both directions from this station in the Skookum tunnel (fig. 3). Although samples were collected on the floor, from the walls and ceiling, and from the mine dust that forms a thick coating on the walls and ceiling of the tunnel within this zone, they showed only low percentages of equivalent uranium (samples 3351, 3352, 3369, and 3379, table 1). The intense radioactivity may be due to a concentration of radon in this part of the tunnel. Perhaps deep channel sampling or drilling in this vicinity would reveal the source of the material that is responsible for the abnormal radioactivity.

No significant radioactivity anomalies were detected by foot traverses made along the Mountain View trail from the Salmon River road to the buildings on the Mountain View property, along the Titan trail from its junction with the Mountain View trail to the Titan tunnel, along the Salmon River and Texas Lake roads from Hyder to Texas Lake, and over parts of the Adanac and Ambrose claims; nor were anomalies found in underground traverses in the Sixmile and Titan drifts and the Riverside mine. (See fig. 1.) The scanning of 43 samples collected by the U. S. Bureau of Mines in the area during 1949 failed to show that any of them were abnormally radioactive.

CONCLUSIONS

The Hyder district, readily accessible by water transportation the year round, is a highly mineralized region and appears to contain ore deposits of potential commercial value. The known ore and gangue minerals of the district (Buddington, 1929) are tabulated below:

anglesite	fluorite	pyrite
ankerite	freibergite	pyrolusite
arsenopyrite	galena	pyrrhotite
azurite	gold	quartz
barite	hematite	rutile
bornite	limonite	scheelite
calcite	magnetite	silver
cerrusite	malachite	specularite
chalcopyrite	marcasite	sphalerite
covellite	molybdenite	tetrahedrite
cubanite	proustite	wulfenite

The chief values of the ores are gold, silver, and lead; zinc, tungsten, and molybdenum also have been found in abundance locally. Through 1949 the Riverside mine had produced lead, silver, and gold for a number of years. In addition, the barren quartz veins, which attain a width of as much as fifty feet on the Mountain View property, represent a possible economic source of silica flux.

In conclusion, it appears that the Hyder district is potentially favorable for the occurrence of uranium in commercial quantities, and prospecting in this district should include the search for radioactive ores as well as for other metals. The radioactivity anomalies found, and the discovery of minor amounts of uranium in 16 different minerals as well as the occurrence of an unidentified, highly radioactive, opaque, uranium-bearing mineral associated with rutile and two secondary uranium-bearing minerals in the very small portion of the area covered by this investigation indicates

that prospecting for uranium in the Hyder district should be encouraged. Furthermore, an extensive detailed radioactivity investigation, using more sensitive instruments and employing geochemical methods of prospecting, such as water, soil, or vegetation sampling, especially at localities which are believed to have been susceptible to mineralization but where few or no outcrops occur, might prove successful in locating a primary source of the uranium as well as determining whether or not uranium occurs in commercial quantities anywhere in the district.

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