

MINERAL DEPOSITS OF KODIAK AND THE NEIGHBORING ISLANDS.

By G. C. MARTIN.

GEOGRAPHY.

POSITION AND SHORE LINE.

Kodiak is one of a group of islands situated south of the entrance to Cook Inlet, Alaska, in latitude $56^{\circ} 30'$ to 59° N. and longitude 152° to $154^{\circ} 45'$ W. They are separated from the Alaska Peninsula by Shelikof Strait, which is about 30 miles in width. The group includes two large islands, Kodiak and Afognak, which are separated by narrow channels, and several smaller ones near by. The entire group lies southwest of Kenai Peninsula. It is in the trend of the Kenai Mountains and is probably part of their submerged extension. The Barren Islands, which lie in the mouth of Cook Inlet, midway between Afognak and Kenai Peninsula, form a link in this broken chain. The group has a seaward extension in the Trinity Islands and Chirikof Island, which lie, respectively, 10 and 80 miles southwest of Kodiak Island.

Kodiak Island is about 100 miles long from northeast to southwest and 60 miles wide from northwest to southeast. It is of roughly quadrangular outline (Pl. V) but is intricately indented by numerous long bays and is almost bisected by Uyak Bay. Afognak Island is about 40 miles long and 25 miles wide and is almost a miniature of Kodiak Island in outline and orientation.

TOPOGRAPHY.

The islands are mountainous throughout. On Kodiak Island the general altitude of the higher summits along the northeast and northwest coasts is from 2,500 to 3,000 feet. The highest mountains are probably near the center of the island, a peak near Uyak Bay (the highest known summit) having an altitude of 4,463 feet. The mountains near the south coast of the island are said to be high and rugged. On Afognak Island the general maximum altitudes are from 2,000 to

2,300 feet. No considerable areas of lowland occur on any of the islands.

The general drainage of both Kodiak and Afognak islands is northwest and southeast from divides lying near the center of each island and extending roughly parallel to its longest dimension. Each bay receives the drainage from its proportion of the area contiguous to it, there being no extensive river systems. The only large stream is Karluk River, and the only important lakes are Karluk Lake on Kodiak Island and Afognak Lake on Afognak Island, which are 13 and 6 miles long, respectively.

VEGETATION.

The low slopes of Afognak Island and of the northeastern part of Kodiak Island are covered with a light spruce forest. On Kodiak Island the limits of the spruce forest are at Uganik and Ugak bays, west of which there are no trees except cottonwood and birch. Timber line is low, there being practically no trees anywhere above an altitude of 1,000 feet. Large areas of grass are found among the woodlands on the gentler hill slopes and in the valleys. The customary growth of bushes and shrubs occurs among and above the forests.

CLIMATE.

The climate of the islands is mild and moist, showing the influence of the surrounding sea. The following tables give a summary of the meteorologic records:¹

Monthly temperature (°F.) at Kodiak and Wood Island from January, 1899, to December, 1910.

	Maximum.	Minimum.	Mean.
January, 10 years.....	53	-8	28.92
February, 10 years.....	58	-3	33.17
March, 11 years.....	65	2	34.60
April, 10 years.....	61	5	36.24
May, 11 years.....	74	20	43.52
June, 11 years.....	82	30	51.11
July, 12 years.....	82	32	53.14
August, 10 years.....	85	31	55.22
September, 10 years.....	77	26	49.41
October, 10 years.....	67	16	41.15
November, 11 years.....	54	9	34.50
December, 9 years.....	61	-12	30.57
For term of record.....	85	-12	40.98

¹ Georgeson, C. C., Ann. Rept. Alaska Agricultural Exper. Sta., for 1902, pp. 302-303; 1903, p. 386; 1904, p. 358; 1905, p. 97; 1906, p. 71; 1907, p. 91; 1908, p. 76; 1909, p. 74; 1910, p. 77.

Monthly precipitation (inches) at Kodiak and Wood Island from January, 1899, to December, 1910.

	Maximum.	Minimum.	Mean.
January, 11 years.....	4.80	1.00	3.23
February, 11 years.....	8.60	.30	4.94
March, 10 years.....	7.46	.00	3.37
April, 10 years.....	7.40	2.60	4.42
May, 11 years.....	6.62	3.35	5.07
June, 11 years.....	7.80	1.55	3.86
July, 10 years.....	6.64	.82	3.75
August, 9 years.....	9.20	1.75	4.17
September, 10 years.....	10.00	.63	4.46
October, 10 years.....	8.95	1.86	6.32
November, 11 years.....	14.11	1.42	5.72
December, 10 years.....	11.10	1.88	5.87
Annual average.....			56.18

SETTLEMENTS, INDUSTRIES, AND TRANSPORTATION.

All the inhabitants of the islands live in small towns and villages situated on the shore. The most important town is Kodiak, or St. Paul, which is situated near the east end of Kodiak Island. Kodiak is the western terminus of a line of steamers from Seattle and is also a port of call for a steamer running monthly from Seward to Unalaska. The only industries of the town are salmon and halibut fisheries.

Other salmon canneries are situated at Larsens Bay, Uyak, Karluk, and Alitak. Russian and native settlements, which are not supported by any important industries, include the villages of Afognak, Uzinki, and Uganik. A salmon hatchery is situated at Litnik on Afognak Island. An agricultural experiment station was established several years ago at Kalsinski, a few miles south of Kodiak. The village of Wood Island, near Kodiak, contains the Kodiak Baptist orphanage.

Grazing and agriculture, which constitute the most important industries of Kodiak Island, next to the fisheries, received a serious but probably only temporary setback in the severe injury to vegetation caused by the eruption of Katmai Volcano in June, 1912. Other local industries are trapping and fox raising.

Mining has never attained the rank of an important industry on these islands, although moderate amounts of placer gold have been obtained from the beaches on the northwest and southwest coasts for many years. A small amount of gold has also been obtained from a lode mine on Uyak Bay. The average net effect of mining and prospecting on Kodiak Island thus far has probably been to impoverish rather than to enrich both the individuals who took part in it and the community as a whole.

All travel in these islands is by water. There are no roads and but few trails. There are no serious difficulties in the way of land transportation, but the water routes are so convenient that there is little need for roads or trails.

GEOLOGY.

GENERAL FEATURES.

The rocks of Kodiak and the neighboring islands consist chiefly of slate and graywacke, cut by numerous but for the most part small intrusive masses, partly granitic. They are probably underlain by metamorphosed schists and overlain by small areas of poorly consolidated Tertiary rocks and by a variety of unconsolidated Quaternary beds. (See Pl. V.) The general sequence is indicated below:

Quaternary:

Alluvial and beach deposits.

Glacial and terrace gravels.

Tertiary:

Sandstones (?).

Lignite-bearing beds (?).

Mesozoic (?):

Granitic intrusive rocks.

Graywacke and slate.

Paleozoic (?): Schist, greenstone, quartzite, and marble.

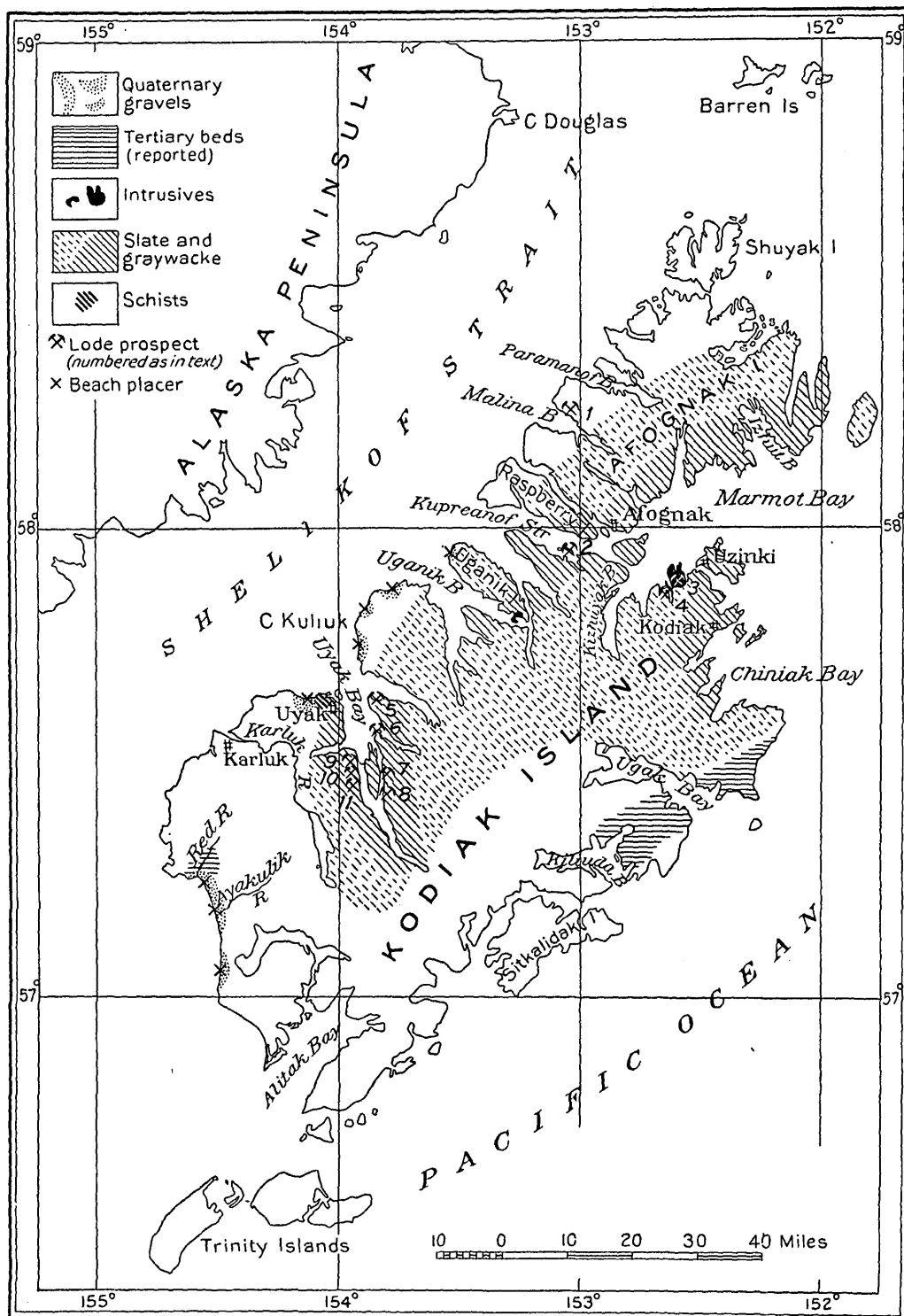
SCHIST.

The schistose rocks of Kodiak Island have been studied only on the northwest shore of the island between Uyak and Sevenmile Beach. It is considered probable that the exposures seen at this point are part of a general belt extending parallel to the northwest shore of the island and outcropping on most or all of the promontories.

These rocks include fine-grained quartzitic schist, crystalline limestone, and chloritic schist. They constitute a group of rocks of diverse lithologic character but of uniform degree of metamorphism and structural complexity. The thickness of the group and of its various members and the stratigraphic relations existing between the members have not been determined.

The associated rocks are cherts and lavas, presumably of Triassic age, and graywackes and slates. The relation of the metamorphic rocks to the associated sedimentary and volcanic rocks is not known.

No evidence as to the age of these schists has been obtained. They are presumably older than the associated Triassic (?) rocks and bear a close resemblance to the more highly metamorphosed rocks of Seldovia Bay, which likewise occur in association with and in an uncertain relation to Triassic cherts and lavas and Mesozoic or older



GEOLOGIC RECONNAISSANCE MAP OF KODIAK AND NEIGHBORING ISLANDS.

slates and graywackes almost identical in character with those of Kodiak Island.

SLATE AND GRAYWACKE.

Slate and graywacke are apparently the most widely distributed rocks on the islands. They compose the entire southeast shore of Afognak Island and the greater part of the northeast and northwest shores of Kodiak Island, and it is considered probable that they extend throughout the greater part of both islands.

These rocks consist of graywacke and slate in approximately equal amounts and in stratigraphic relationships which have not been made out. There are alternations of moderately thin beds of each kind of rock and also more massive aggregates of each kind. The stratigraphic relations of the aggregates to one another and to the alternating beds have not been determined. The presence of a subordinate amount of conglomerate is indicated by a few boulders.

The slates and to a lesser degree the graywackes have a well-developed secondary cleavage which has thoroughly obliterated the bedding except where there is a well-defined change in composition.

The strike ranges from N. 3° W. to N. 75° E., averaging about N. 28° E. (magnetic), and the observed dips range from 20° to 80° NW., averaging about 56° NW. The structures are complex and are probably dominantly isoclinal. The structural details are not known.

The graywacke is composed of grains of quartz and fragments of shale, chert, oligoclase, albite, secondary sericite which was derived in part from feldspar, chlorite, and oxides of iron, in a fine-grained siliceous shaly matrix.

INTRUSIVE ROCKS.

The intrusive rocks consist chiefly of a large number of small dikes and sills, which are present throughout practically the entire area of the graywacke and slate. Larger intrusive masses were also seen east of Kizhuyak Bay and at the south end of Uganik Island. The coarser intrusive rocks include quartz-mica diorite and mica granodiorite. Quartz-mica diorite, porphyrite, and keratophyre were recognized among the small dikes.

Large areas of granitic rocks probably exist in the interior of Kodiak Island. A granitic mass which was not observed by the writer was described by Becker¹ as follows:

The southern end of the ridge running along the westerly coast of Kodiak Island is called Saddleback and is granitic, and boulders found on this coast seem to indicate that there is an area of the rock of considerable size. * * * A pebble or boulder from the west coast of Kodiak is a normal muscovite granite. * * *

¹ Becker, G. F., Reconnaissance of the gold fields of southern Alaska: U. S. Geol. Survey Eighteenth Ann. Rept., pt. 3, p. 36, 1898.

Intrusive rocks present in the vicinity of Karluk were described by Becker ¹ as follows:

At Karluk, on the northwest coast of Kodiak Island, there are magnificent cliffs of an interesting hypidiomorphic diorite. The face of the cliffs * * * is partly gray and partly black, the two colors manifestly belonging to allied rocks which, however, are so mingled that it seems impossible to determine by mere inspection whether they represent successive intrusions, imperfectly separated masses, or a partial solution of one material in the other. The rock is extremely fresh and under the microscope is seen to vary in composition with the color. The gray rock is a quartz diorite containing hornblende, biotite, and labradorite. The analysis of this rock given below, made by Dr. W. F. Hillebrand, evidently answers to the composition ascertained under the microscope. The dark streaks and patches are more porphyritic than the gray portions just described. They consist of a peculiar reddish feldspar with the optical qualities of anorthite, embedded in a groundmass composed mainly of green hornblende, a little biotite, and quartz mingled with some feldspar. The microlites of the groundmass as well as the phenocrysts are anorthite. Needles of apatite and grains of magnetite are also present. The black diorite contains much more lime and much less soda than the gray material, as the partial analysis given below shows. Considering the relations of the chemical composition, it appears to me probable that the dark material in this diorite corresponds to the blebs so often found in granite and granodiorite, and that while the two materials have always been associated they have never been thoroughly mingled.

Analysis of Karluk diorite.

[By W. F. Hillebrand.]

	No. 213.	No. 211 (ferro- magnesian facies).
SiO ₂	61.58	54.26
TiO ₂.....	.63	.....
Al ₂ O ₃	15.89	.....
Fe ₂ O ₃	2.19	.....
FeO.....	5.50	.....
MnO.....	.20	.....
CaO.....	6.49	8.88
BaO.....	.06	.....
MgO.....	2.69	.....
K ₂ O.....	.51	.64
Na ₂ O.....	3.04	1.99
H ₂ O below 110° C.....	.16	.....
H ₂ O above 110° C.....	1.26	.....
P ₂ O ₅.....	.12	.....
FeS ₂.....	.06	.....
	100.38	.....

TERTIARY ROCKS.

Strata of Tertiary age have been reported from several localities on Kodiak Island. As none of these places have been visited by the writer the following descriptions by Dall ² are quoted:

Tertiary beds occur in various places on the islands of the Kodiak group, both of Kenai age and of the later Unga beds containing Miocene marine fossils.

¹ Becker, G. F., Reconnaissance of the gold fields of southern Alaska: U. S. Geol. Survey Eighteenth Ann. Rept., pt. 3, pp. 41-42.

² Dall, W. H., Report on coal and lignite of Alaska: U. S. Geol. Survey Seventeenth Ann. Rept., pt. 1, pp. 800, 843, 1896.

On the island of Kodiak marine Miocene strata are found, and among the specimens brought back by Wossnessenski were clay ironstones containing plant remnants referable to the Kenai group. These stones were used by the native women for reddening the inner surface of dressed skins, and the only indication of locality for them is that they came from the northern part of the island. About the middle of the island, surrounding Ugak Bay, at the old settlement of Orlovsk, and on the north shore of Miliuda [Kiliuda] Bay next southward, and on the opposite side of the island, part of the shores of Uganuk Bay and of Uganuk Island in the bay, sandstones with lignite in thin seams overlain in places by marine sandstones like those of Unga, are reported on the authority of Kharitonoff and other Russians familiar with the island.

On the island of Kodiak, north of Tonki [Narrow] Cape, on the south coast from the shores of Igatskoi [Ugak] Bay, Wossnessenski collected a number of species of this fauna [of the "Astoria group"] which were embedded in a volcanic tuff about 10 feet above the sea. On the opposite side of the island, near the settlement of Uganuk, similar beds were found containing analogous fossils.

At the head of the bay into which Red River falls Messrs. Becker and Purington obtained specimens of *Cardium*, etc., in a brownish sandstone evidently belonging to the horizon of the Astoria Miocene.

QUATERNARY DEPOSITS.

The unconsolidated Quaternary deposits include glacial detritus, recent alluvial and beach deposits, and the covering of volcanic detritus which was deposited over much of these islands in 1912.

The glacial deposits are of wide extent, the entire area, except possibly the higher mountains, apparently having been overridden. The best observed development of these deposits is on the northwest shore of Kodiak Island both east and west of Uyak Bay. At Seven-mile Beach, west of Uyak Bay, a bluff about 60 feet high is composed of till. Similar bluffs occur between the entrance to Uyak Bay and Cape Kuliuk and probably at many other places.

The alluvial and beach deposits are of the same general character as those on similar streams and shores and call for no especial comment.

The volcanic deposits from the eruption of Mount Katmai in June, 1912, extend over all of Afognak Island and Kodiak Island as far west as Uyak Bay.

MINERAL RESOURCES.

GOLD LODE DEPOSITS.

KODIAK ISLAND.

The lode deposits of Kodiak Island occur as quartz veins in both the slaty and the granitic rocks. The slates and graywackes are almost everywhere cut by a multitude of minute quartz veins, which in various parts of the island attain considerable size and carry sulphides. No law regarding geographic distribution, relationship to lithology, structure, or intrusives has been established.

The older prospects on Uyak Bay were not examined by the writer, but they have been described by Becker¹ as follows:

Several small prospects exist on Uyak Bay, Kodiak Island. * * * The Bear, Dan, and Calaveras claims lie close together, the first two on what is supposed to be the same vein, and the last on a second, nearly parallel vein. The country rock is a carbonaceous schist or slate, and the fissures cut the cleavage. The Bear vein [No. 11, Pl. V] strikes N. 25° W. (true) and dips in a southwesterly direction at 40°. In width it varies from a few inches to about 6 feet and averages perhaps 2½ feet. The quartz is usually solid but is not entirely free from included schist fragments. A number of fine outlying parallel stringers accompany the vein. The sulphurets are arsenopyrite and pyrite, the former predominating. Free gold is easily panned from the croppings, and some extraction has been effected with an arrastre, but I was not able to ascertain yield or tenor.

The Dan [No. 10, Pl. V] is about 500 yards from the Bear and on its strike, but the deposit has not been traced through the heavy timber. The vein is about 2 feet in width and contains the same sulphurets. The mispickel here is well crystallized and the general appearance of the quartz is good. No work was in progress and scarcely any has been done. The Calaveras [No. 9, Pl. V] lies to the northeast of the Dan, on a similar vein of the same strike. It is about 20 inches wide and shows pyrite, mispickel, and galena.

The Lake claim [No. 6, Pl. V] is about 4 miles north of the Bear and on the east shore of the bay. The vein at this point strikes N. 70° E. (true) and dips 80° S., cutting the slate, which is here manifestly of sedimentary origin. The vein is only a foot wide, and the only sulphuret observed in it was a very little mispickel. This vein lies on one of a double series of joints forming a nearly rectangular system. On the shore below the vein is a neat illustration of the mechanism of jointing. The partings cross both sandstone and shale. In the sandstone the joints are from one-fourth to one-half inch wide and filled with quartz, but in the shale the same cracks are so narrow as to be scarcely visible, although sometimes carrying quartz. Evidently the shale yielded far more prior to rupture than did the sandstone.

The Wamberg and Boyer [No. 5, Pl. V] is 10 miles north of the Bear and near the entrance of Uyak Bay. The prospect is on a veinlet 7 inches wide, striking N. 55° E. (true) and dipping 65° SE. It lies in sedimentary schist and conforms nearly in strike, less nearly in dip. Near by excellent glacial modeling and scratches were observed.

The prospects of the Amok Gold Mining Co. and associated properties are situated on the east shore of Uyak Bay, east of Amok Island (No. 7, Pl. V). Several quartz veins, all of which are reported to be gold bearing, cut the country rock, which is black slate having a well-defined cleavage. The general strike of the cleavage is N. 15° E. (magnetic) and the dip is 75° NW. The bedding of the slate is much disturbed and difficult to recognize, but at one point a strike of N. 35° E. (magnetic) and a dip of 47° NW. were observed. A small intrusive mass of sill-like habit cuts the slates. This rock was determined as keratophyre.

The principal vein outcrops approximately parallel to the shore, striking N. 45° W. (magnetic) and dipping 80° SW. It is said to

¹ Becker, G. F., Reconnaissance of the gold fields of southern Alaska: U. S. Geol. Survey Eighteenth Ann. Rept., pt. 3, pp. 80-81, 1898.

average 3 feet thick with a maximum of 5 feet and is composed of quartz with a small proportion of pyrite, no other constituents being visible to the naked eye. The number and persistence of the larger veins are uncertain, but the slates are cut by a multitude of minute quartz veins, some of which pass into zones of multiple fracturing in which there are aggregate bodies of quartz of considerable magnitude. Most of these minor veins are parallel to the cleavage, though a few cut across it at various angles, some of which are as great as 90° .

The underground developments consist of an adit 210 feet long, a shaft 130 feet deep, two drifts 130 and 50 feet in length, and several surface prospects. Two mills of 5 and 10 stamps, respectively, several hundred feet of pipe line furnishing water under high pressure for power, and other outside improvements have been installed. The mills have not run yet.

A quartz vein outcropping on the beach near the present workings of the Amok Gold Mining Co. was mined by Mr. Wanberg several years ago. It is said that he took out about \$8,000 in three or four years with an arrastre.

Matson's ledge is about one-half mile south of the Amok Gold Mining Co.'s property (No. 8, Pl. V) and consists of a 6 to 10 inch quartz vein striking N. 55° W. (magnetic) and dipping 60° SW. The country rock is slate and fine-grained graywacke, whose bedding (?) or cleavage strikes N. 10° E. (magnetic) and dips about vertical. A short adit and several open cuts were the only improvements seen on this property.

The Bear mining claim is situated one-half mile south of the head of Womans Bay, or 5 miles west of Uzinki, at an elevation of about 740 feet (No. 3, Pl. V). The ore body is 4 feet 2 inches wide at the surface and trends N. 60° W. (magnetic). The ore consists of pyrrhotite with considerable amounts of sphalerite and very small quantities of chalcopyrite. The only gangue mineral noted is quartz. Both walls are of mica granodiorite, locally known as granite, which is the only rock noted in the vicinity.

Several other prospects are situated in the vicinity of the group of islands at the mouth of the easternmost arm of Kizhuyak Bay (No. 4, Pl. V). They are probably in or near the same large granitic mass described above.

AFOGNAK ISLAND.

At a prospect on Malina Bay, Afognak Island, there is said to be a quartz vein 14 feet wide carrying gold and a little silver. The vein is said to occur at the contact of slate with granite and diorite and to be cut by a porphyry dike.

According to information received from another source, an adit 140 feet long was driven several years ago on a gold and silver bearing

vein at the mouth of the second creek inside the entrance to Malina Bay on the north shore (No. 1, Pl. V). This locality may or may not be the same as that mentioned above.

GOLD PLACERS.

DISTRIBUTION AND CHARACTER.

Placer gold has long been known to occur in the beach gravels on the north and west coasts of Kodiak Island. These placers are not rich, yet they have yielded an amount of gold which is very considerable in the aggregate, probably running from \$3,000 to \$10,000 a year. The better known are those at Sevenmile Beach west of Uyak, those on Uganik Island, and those at various localities near Red River and elsewhere on the west coast of Kodiak Island. Those at Sevenmile Beach are the only ones which the writer has examined. Those on the west coast, which yielded most of the gold taken out in 1912, were examined by Becker in 1895.

Sevenmile Beach is situated on the stretch of coast between Bear Island and Rocky Point west of Uyak. It is a broad sand and gravel beach behind which are bluffs of till about 60 feet high. The beach sands at this locality have yielded a moderate amount of placer gold, most of which was obtained in a distance of about $3\frac{1}{4}$ miles along the shore. The greater amount of the gold was obtained near the base of the bluff and on a "clay bedrock" (till) which lies 1 to 6 feet beneath the surface. The pay streak, which was from 12 to 18 inches thick, is said to be now worked out. The gold was obtained mostly in sluice boxes, although some rockers were used. Nuggets worth as much as 25 cents were obtained. It is said that as much as \$10 per day per man was obtained at the richer localities. The deposit is evidently a wave concentration from the glacial deposits which form the bluff.

The beach placers on the west coast of Kodiak Island were extensively worked during the summer of 1912. As the writer was unable to visit these localities the following description by Becker ¹ is quoted:

Gold washing was in progress during my visit to the western shore of Kodiak Island, at Portage River and Ayakulik River. The beaches here lie along a bluff averaging 50 feet or more in height, which limits an extensive grassy plain. This represents a very recent uplift, which has been general throughout western Alaska, elevating most parts of Kodiak, Chirikof, Tugidak, and other islands. The recency of the elevation is shown by the fact that the little streams draining the low, flat plateaus have made small progress in cutting back into the bluffs. * * * At the beach washing the bluffs as well as the beaches carry streaks of black sand, and those in the bluffs are said to be auriferous as well as those at tide level. The source of the gold is doubtless in the ranges which lie several miles to the east of the bluffs. Pebbles of granite and metamorphic rock are found on the shore and have accompanied the gold

¹ Becker, G. F., Reconnaissance of the gold fields of southern Alaska: U. S. Geol. Survey Eighteenth Ann. Rept., pt. 3, p. 86, 1898.

from its original position. The gold-bearing sands do not occur in masses but in patches perhaps an inch in thickness and extending over a few square yards. When such a patch is found the material must be gathered and carried out of reach of the waves, which constantly shift the sands from place to place. The Kodiak sands consist of magnetite, garnet, quartz, slate, serpentinitoid material, and very light scaly gold. The gold floats easily and does not seem to amalgamate well. No doubt much of it is lost, and some new process, such as cyaniding, must be adopted before large profits can be made from any but exceptionally rich beach sands.

Cliffs of unconsolidated deposits along much of the shore between Cape Kuliuk and the entrance to Uyak Bay resemble those back of Sevenmile Beach. They were not examined closely, but are believed to be of glacial origin. At other localities along the northwest coast of Kodiak Island placer gold has been found in most of the beaches lying at the base of low alluvial bluffs. A notable occurrence of this kind is at the western end of Uganik Island, where considerable amounts of gold have been taken out from time to time.

ORIGIN.

The important gold placers of Kodiak Island, so far as known, all occur where there is violent wave action, on cliffs composed of Quaternary deposits. The Quaternary deposits, which constitute the secondary source of the gold, are of local and not of widespread occurrence. All these Quaternary deposits (Pl. V) seem to lie at the mouths of valleys which terminate on the open coast and not at the heads of bays. Those at Sevenmile Beach consist of till. Some of the others, such as those on the west coast of Kodiak Island and probably those between Cape Kuliuk and Uyak Bay, consist at least partly of stratified gravels. All are believed to be closely related to glaciation and to have been deposited either directly by glaciers which had their fronts near the present shore line or in waters which were ponded in the present mouths of the valleys by the large glacier that once flowed past the island. Recent earth movements may or may not have brought the deposits into their present position relative to sea level.

The ultimate source of the gold may have been either in the slates and graywackes, which are known to contain a multitude of small quartz veins, some of which carry gold, or in lode deposits occurring in rocks of possibly different character in the interior of the island. The former glaciation of the island makes it practically hopeless to attempt to trace the gold to its source.

The important fact to be considered in a search for workable deposits is that prospecting has hitherto yielded valuable placers only where active reconcentration of old gravels has taken place. The old gravels are of considerable volume, but are of local occurrence. They do not appear to carry gold in sufficient concentration to be worked,

but so far as known they have not been adequately prospected at their base nor in places where the richest concentration would be expected. The old gravels appear to have yielded valuable placers wherever they have been actively reworked, as by the waves, and it hence appears that gold is probably well distributed throughout them. Localities where these deposits have been reworked by active streams would appear to be worthy of prospecting. The streams which drain the known gravel areas are mostly small and probably have not accomplished any considerable amount of reconcentration.

COAL.

The only coal known on Kodiak Island is that near Red River, which was described by Dall¹ as follows:

Coal exists in a clay bank near the beach at Red River, Kodiak, of which a specimen was obtained by Dr. Becker and Mr. Purington. An analysis affords the following data:

Analysis of coal from Red River, Alaska.

Moisture.....	12.31
Volatile matter not moisture.....	51.48
Coke.....	33.80
Ash.....	2.41

The coke was sooty and noncoherent. The percentage of sulphur to the whole coal was 0.17.

The existence of coal is also known on Sitkinak Island, southwest of Kodiak, the following description being given by Stone:²

Coal occurs on the high island of Sitkinak,³ one of the Trinity Islands, at the southern end of the Kodiak group. In the rocks which outcrop boldly on a lagoon on the northeast side of the island there are a number of seams of coal, one of which is said⁴ to be 10 to 12 feet thick, standing vertically in a bluff 20 feet high. The deposit is somewhat limited in extent. Some schooners have sometimes visited this locality to get a boatload of coal, which can be obtained handily from the beach. It makes steam readily but is inconveniently situated for access by large vessels. The almost constantly raging surf beating around the shallow coast is a serious obstacle.

Stone⁵ also quotes Francis to the effect that the Tertiary rocks at Kiliuda Bay contain two coal beds, probably 6 to 8 inches thick.

¹ Dall, W. H., Report on coal and lignite of Alaska: U. S. Geol. Survey Seventeenth Ann. Report; pt. 1, p. 800, 1896.

² Stone, R. W., Coal resources of southwestern Alaska: U. S. Geol. Survey Bull. 259, p. 163, 1905.

³ Alaska Eleventh Census Rept., p. 78, 1893.

⁴ Information from P. W. Francis, of Seattle.

⁵ Op. cit., p. 163.