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

By EDWARD H. COBB, ALEXANDER A. WANEK, ARTHUR GRANTZ, *and* CLAIRE CARTER

STUDIES RELATED TO WILDERNESS—WILDLIFE REFUGES

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STUDIES RELATED TO WILDERNESS

WILDLIFE REFUGES

The Wilderness Act (Public Law 88-577, Sept. 3, 1964) directs the Secretary of the Interior to review roadless areas of 5,000 contiguous acres or more, and every roadless island, within the national wildlife refuges and game ranges under his jurisdiction and to report on the suitability or nonsuitability of each such area or island for preservation as wilderness. As one aspect of the suitability studies, existing published and unpublished data on the geology and the occurrence of minerals subject to leasing under the mineral leasing laws are assembled in brief reports on each area. This bulletin is one such report and is one of a series by the U.S. Geological Survey and the U.S. Bureau of Mines on lands under the jurisdiction of the U.S. Department of the Interior.

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By Edward H. Cobb, Alexander A. Wanek, Arthur Grantz, and Claire Carter

SUMMARY

The Bering Sea, Bogoslof, Forrester Island, Hazy Islands, St. Lazaria, Semidi, Simeonof, and Tuxedni National Wildlife Refuges, off the coast of Alaska, have been studied to determine whether, from a mineral resources viewpoint, they are suitable for inclusion into the National Wilderness Preservation System. Minerals subject to leasing under the mineral leasing laws have received principal attention. These minerals are oil and gas, oil shale, asphalt and bituminous sands, coal, phosphate, and sodium and potassium compounds.

Islands that constitute the Bering Sea, Bogoslof, Forrester Island, St. Lazaria, Semidi, and Simeonof refuges are made up mainly of igneous rocks. Hazy Islands are made up of sedimentary and metamorphic rocks. Sedimentary rocks of Jurassic age underlie the Tuxedni refuge.

None of the refuges contain known deposits of either leasable minerals or minerals subject to location under U.S. mining laws. Oil and gas seeps occur in sedimentary rocks at Oil Bay about 40 miles southwest of Chisik Island, the site of the Tuxedni National Wildlife Refuge. Eight test wells drilled at Oil Bay had numerous oil and gas shows in rocks of the Tuxedni Group, but there has been no commercial production. No test wells for oil and gas have been drilled on Chisik Island, but the absence of favorable geologic structures and the fact that reservoir rocks are at the surface preclude favorable possibilities.

No mineral production is known from any of the refuges, and the mineral resource potential of them is considered to be poor.

INTRODUCTION

Information presented in this report is based on investigations of the U.S. Geological Survey, and the location of the refuges studied is shown in figure 1. The various sections have been prepared from data contained in the published sources listed under "References cited."

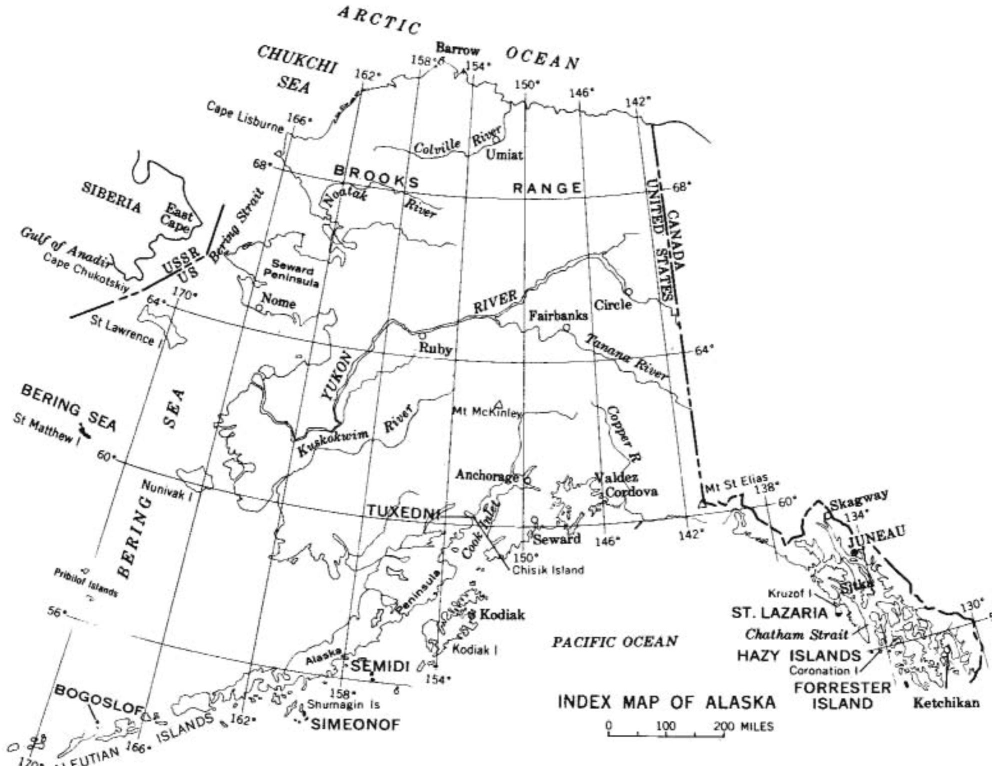


FIGURE 1.—Index map of Alaska showing location of Bering Sea, Bogoslof, Simeonof, Semidi, Tuxedni, St. Lazaria, Hazy Islands, and Forrester Island National Wildlife Refuges.

In some instances these sources have been supplemented by the study of vertical aerial photographs. In addition, data collected during other Geological Survey investigations by Arthur Grantz in the Simeonof refuge and by L. J. P. Muffler in the Hazy Islands refuge have been utilized.

Areas of islands, except Chisik Island (site of Tuxedni National Wildlife Refuge), were calculated by Susan R. Bartsch from measurements made with a polar planimeter on published Geological Survey quadrangle maps at scales of 1:63,360 (1 inch equals 1 mile) and 1:250,000 (1 inch equals approximately 4 miles).

In the absence of mineral production or known deposits, the U.S. Bureau of Mines has not examined the refuges, but the Bureau is informed of the findings of the Geological Survey and concurs in them.

BERING SEA NATIONAL WILDLIFE REFUGE

By Edward H. Cobb

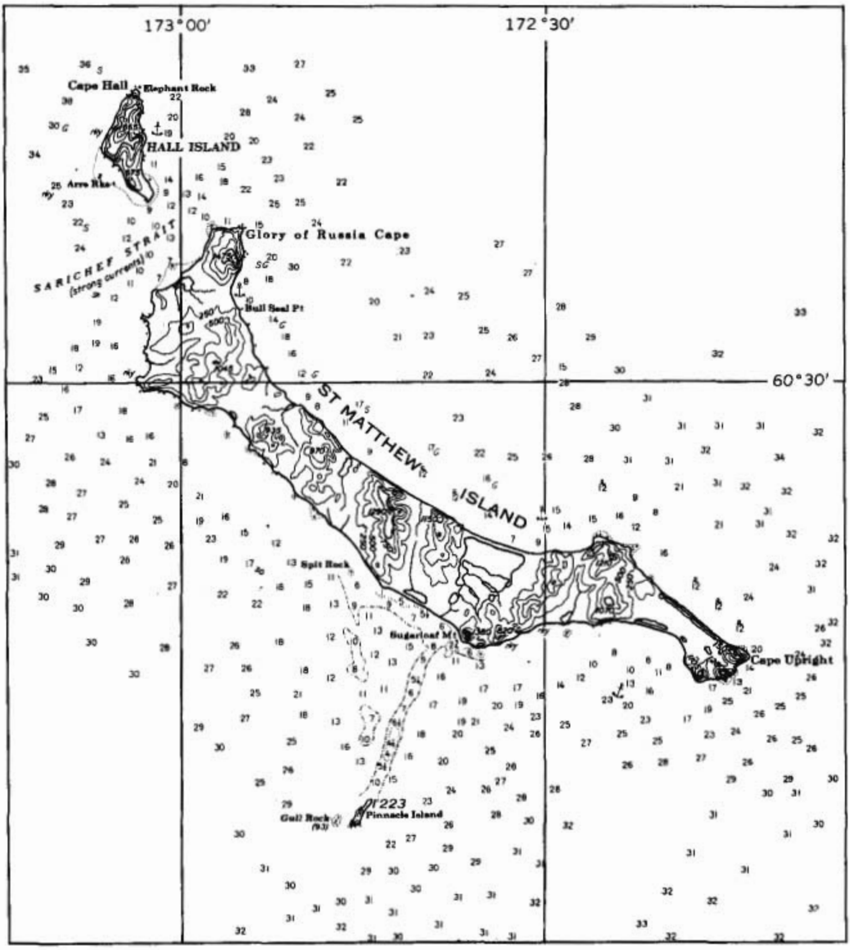
SUMMARY

The islands and offshore rocks that constitute the Bering Sea National Wildlife Refuge are made up of volcanic rocks and surficial deposits. No deposits of minerals subject to leasing under the mineral leasing laws or to location are known in the refuge.

INTRODUCTION

The uninhabited islands that constitute the Bering Sea National Wildlife Refuge are near lat 60°30′ N. and long 173° W. in the middle of the Bering Sea, more than 200 miles from the Alaska mainland and about 375 miles southwest of Nome, the closest city. Cape Chukotskiy, the nearest point on the Siberian mainland, is about 250 miles to the north (fig. 1).

The Bering Sea refuge is made up of St. Matthew, Hall, and Pinnacle Islands and offshore rocks (fig. 2). St. Matthew, the largest island, was discovered and named by Sind in 1766 and was visited 12 years later by Capt. James Cook (Baker, 1906, p. 543). It is about 30 miles long, from less than 2 to about 6 miles wide, and has an area of approximately 125 square miles. Several mountains exceed 1,000 feet in elevation; the highest mountain, 1,505 feet in elevation, is at Cape Upright at the southeast end of the island. From a distance St. Matthew appears to consist of 10 or 12 separate masses, but actually these are connected by low spits of sand and gravel. The highest points are bare, the lowlands mainly tundra, and the intervening slopes covered with swampy moss and grass (Flint, 1958, p. 131). Hall Island, 3 miles from the north end of St. Matthew, is triangular in



From U.S. Coast and Geodetic Survey
Nautical Chart 8851

0 5 10 MILES

CONTOUR INTERVAL 250 FEET
SOUNDINGS IN FATHOMS

FIGURE 2.—Map of Bering Sea National Wildlife Refuge.

shape and about 6½ square miles in area. Its summit, a 1,665-foot-high peak, is the highest point in the refuge. Pinnacle, the third island in the group, lies 9 miles southwest of Sugarloaf Mountain on St. Matthew and is joined to the larger island by a submerged ridge about 300 yards wide between the 10-fathom curves (U.S. Coast and Geodetic Survey, 1964, p. 260–261). Pinnacle Island is about 1½ miles long, less than one-half mile across at its widest point, and reaches a height of 1,223 feet.

The islands are surrounded by pack ice for much of the year and are fog shrouded during most of the short navigation season (Flint, 1958, p. 131). Although there are no harbors, the U.S. Coast and Geodetic Survey (1964, p. 260) describes several places where ships can anchor but states that landing is difficult when there is any swell because the beach is steep and stony.

GEOLOGY

The geology of St. Matthew and the adjacent islands is not known in detail. Dall (1896, p. 849), who visited the islands in 1880, stated: "St. Matthew and its adjacent islets are composed of porphyritic, granitic, and volcanic rocks." Dawson (1893, p. 135–138) visited the islands for 3 days in 1891 and landed on St. Matthew and Hall Islands. He described several occurrences of pyroclastic rocks of "porphyrite," some of which exhibited columnar jointing. He also published a diagrammatic section (Dawson, 1893, fig. 5) of the gently north-dipping rocks on Hall Island. Dawson saw only weathered rocks of volcanic origin but nothing that could be related to recent activity; from this he concluded that the rocks were older than the volcanic rocks on some of the other islands in the Bering Sea. In 1916 Hanna visited St. Matthew and reported that many petrified trees were exposed in a cliff about 2 miles south of Glory of Russia Cape (Hanna, 1927, p. 450). Dutro and Payne (1957) showed St. Matthew and Hall Islands as being made up of Quaternary and Tertiary volcanic rocks. The area covered by the refuge is part of the Bering-Chukchi platform, much of which was exposed at various times during the Cenozoic era as the Bering Sea land bridge (Hopkins, 1959). At such times the present islands rose as an isolated range of hills above a relatively featureless plain.

MINERAL RESOURCES

There are no deposits of minerals subject to leasing under the mineral leasing laws in the refuge. Although the lack of detailed knowledge of the geology of St. Matthew and the adjacent islands makes it impossible to state positively that there are no deposits of minerals subject to location, their presence is highly unlikely. None have been found on other geologically similar, better explored islands in the Bering Sea. The isolation of the islands precludes other than local uses of the volcanic bedrock or beach sands and gravels as construction materials.

BOGOSLOF NATIONAL WILDLIFE REFUGE

By CLAIRE CARTER and EDWARD H. COBB

SUMMARY

The two islands that make up the Bogoslof National Wildlife Refuge—Bogoslof and Fire Islands—have been formed by volcanic eruptions within historic time. No deposits of minerals subject to leasing under the mineral leasing laws or to location are in or near the refuge.

INTRODUCTION

This summary is based mainly on a report prepared by F. M. Byers (1959, p. 353–361) as part of the Geological Survey's investigations of Aleutian volcanoes in cooperation with the Military Intelligence Division of the Office, Chief of Engineers, U.S. Army. All data are as of 1947, the year of Byer's fieldwork, unless otherwise stated.

Bogoslof Island is the top of a submarine volcano near lat 54° N. and long 168° W. about 825 miles southwest of Anchorage (fig. 1). The island rose above sea level on May 18 (St. John's Day), 1796, and was named Joanna Bogoslova or St. John the Theologian's Island by the Russians (Baker, 1906, p. 142). Eruptions known to have occurred in 1796, 1883, 1906–7, 1910, and 1923–27, and almost certainly others that were not recorded, have completely changed the topographic features several times.

Bogoslof refuge now consists of one main island, accessible only by small boat in calm weather, and a rocky islet called Fire Island (fig. 3). The main island, known for a time as Castle Island because of a castle-shaped rock on it , is about 1 mile long and one-fourth mile wide at its widest part and has an area of less than one-half square mile. The southern end terminates in a low, black sand spit which is now the haul-out place of a large number of sea lions. A 141-foot-high volcanic crater on the northwest part of the island occasionally emits steam. Next to the crater is a salt-water lake. Castle Rock, on the southwest part of the main island, consists of two main pinnacles, 333 feet and 269 feet high, that appear to have had approximately the same size and shape since 1906 (U.S. Coast and Geodetic Survey, 1964, p. 193–194; Byers, 1959, p. 354). The rocky part of the island is the home of thousands of birds. Fire Island, a steep, rocky islet 220 yards long and 100 yards wide with a maximum elevation of 225 feet, is about one-fourth mile northwest of the main island (U.S. Coast and Geodetic Survey, 1964, p. 194).

GEOLOGY

All rocks exposed on Bogoslof and Fire Islands are of historic age. Igneous rock units are: vent agglomerate and andesite that formed

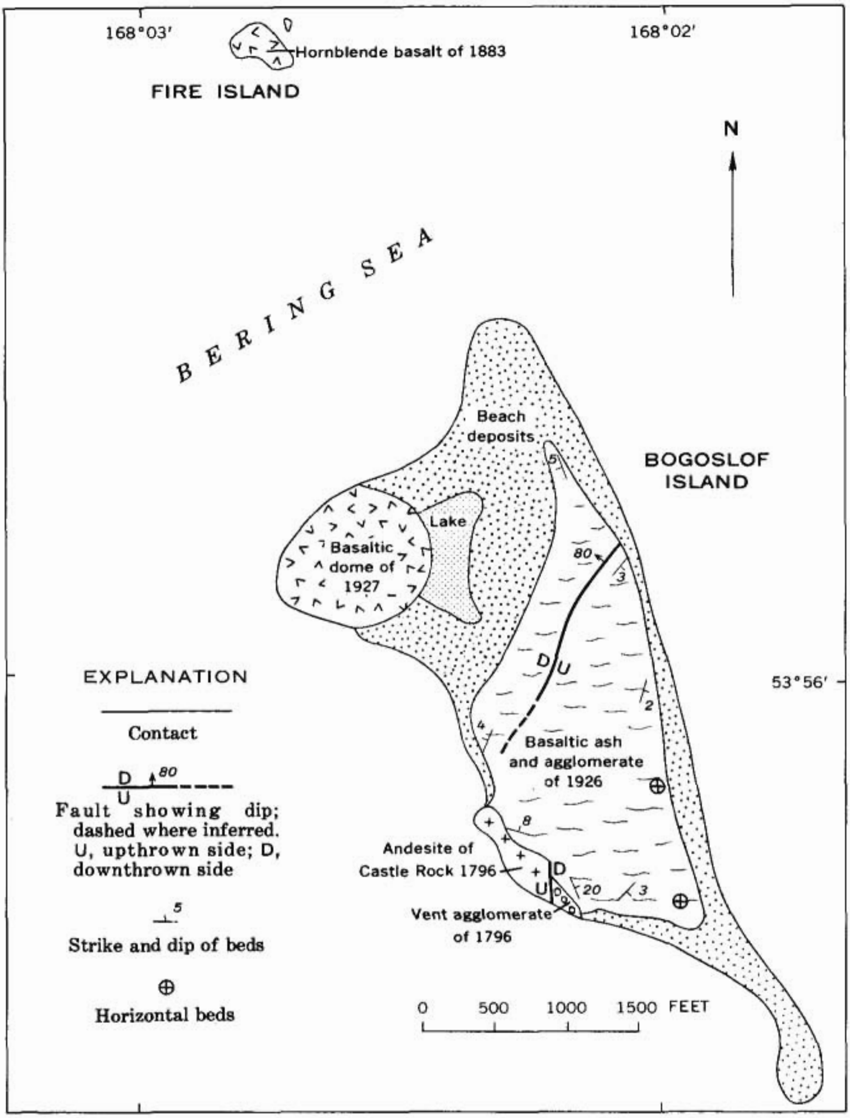


FIGURE 3.—Geologic map of Bogoslof National Wildlife Refuge. From Byers (1959).

Castle Rock in 1796, hornblende basalt of 1883 on Fire Island, basaltic ash and agglomerate of the 1926 and earlier explosive eruptions on Castle Rock, and a basalt dome extruded in 1927 on northwestern Bogoslof (fig. 3). Two high-angle faults slightly displace some of the volcanic rocks. Basaltic ash and agglomerate of the explosion of 1926 are plastered against the steep north and east cliffs of Castle Rock and form an extensive terrace that slopes to the northeast. The youngest volcanic unit in the wildlife refuge is the dome formed in 1927 by the viscous extrusion of basalt at the westernmost bulge of Bogoslof Island.

Beaches composed of rounded cobbles and boulders as much as 6 feet in diameter extend southeastward from Castle Rock and both northeastward and southeastward from the rocky cliffs cut in the basalt dome. Sand makes up the beach east of the area underlain by ash and agglomerate and the beach at the southeastern spit of Bogoslof. Sand and gravel containing scattered cobbles and boulders border the salt-water lake on three sides and merge into the beaches.

MINERAL RESOURCES

There are no deposits of minerals subject to leasing under the mineral leasing laws or to location in the Bogoslof National Wildlife Refuge. Isolation precludes any possibility of utilizing the volcanic rock or beach deposits as construction materials.

SIMEONOF AND SEMIDI NATIONAL WILDLIFE REFUGES

By Arthur Grantz and Edward H. Cobb

SUMMARY

Granitic rocks and surficial deposits make up the islands and islets in the Simeonof and Semidi National Wildlife Refuges. No deposits of minerals subject to leasing under the mineral leasing laws or to location are known in either refuge.

INTRODUCTION

This report is based on a 3-day reconnaissance of the outer Shumagin Islands by Grantz in June 1962, some of the results of which have been published (Grantz, 1963), and on other published reports.

Simeonof Island, the most easterly of the Shumagin Islands, is near lat 55° N. and long 159° W. and is about 330 miles from Kodiak, the nearest city and major supply center (fig. 1). The Shumagin Islands (fig. 4) were named by Vitus Bering for one of his sailors who died and was buried there in 1741 during Bering's second voyage, the exploration which discovered Alaska (Baker, 1906, p. 573). It is noteworthy that Georg Wilhelm Steller, who made the first recorded geologic observations in Alaska while serving as physician and naturalist for Bering on this voyage, recorded each major rock type in the outer Shumagins in his journal (Grantz, 1963, p. B106; Golder, 1925, p 79). Simeonof was called Semenovskiye (Simon) by the Russians and has

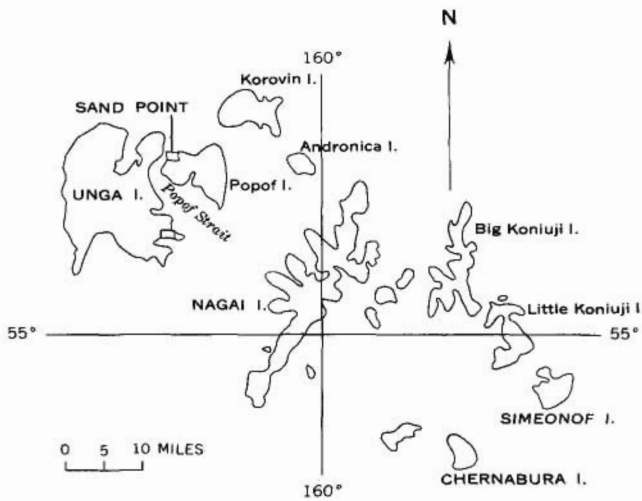


FIGURE 4.—Map of Shumagin Islands. From Grantz (1963).

been known since by that name, by the native name Tiakinak, and by variants of both (Baker, 1906, p. 576).

Simeonof Island (fig. 5) rises as an erosional remnant from a broad shoal on the Shumagin-Kodiak Shelf and is composed of two bedrock islands joined by a sand bar. The composite island is crudely equidimensional and has a total area of about 17½ square miles. Steep hills with bedrock at or near the surface occupy an aggregate area of about 3½ square miles; the hills are surrounded by a lake-dotted surface of low relief that is underlain by surficial deposits. The island can be reached by light plane, small- or medium-sized boat, or helicopter from Sand Point (fig. 4), a town with a population of about 225 that is served by a scheduled airline from Anchorage. Early in the 20th century Simeonof Island was used as a blue-fox farm (Baker, 1906, p. 576), and it has since been the site of a cattle ranch. In 1962 several dozen beef cattle and a few horses were on the island, but there were no permanent inhabitants, though at the head of Simeonof Harbor there was a modest ranchhouse, with outbuildings, that appeared habitable (fig. 5). Simeonof Harbor, which is on the west side of the island near its north end, is protected from winds, and the inner anchorage has 2 fathoms of water at low tide. Small airplanes having wheels can land on a beach near the harbor. Vegetation is restricted to a few trees planted near the ranch buildings and to low Arctic-type plants.

The Semidi National Wildlife Refuge comprises the Semidi Islands, which are near lat 56° N. and long 157° W. and lie about 50 miles from

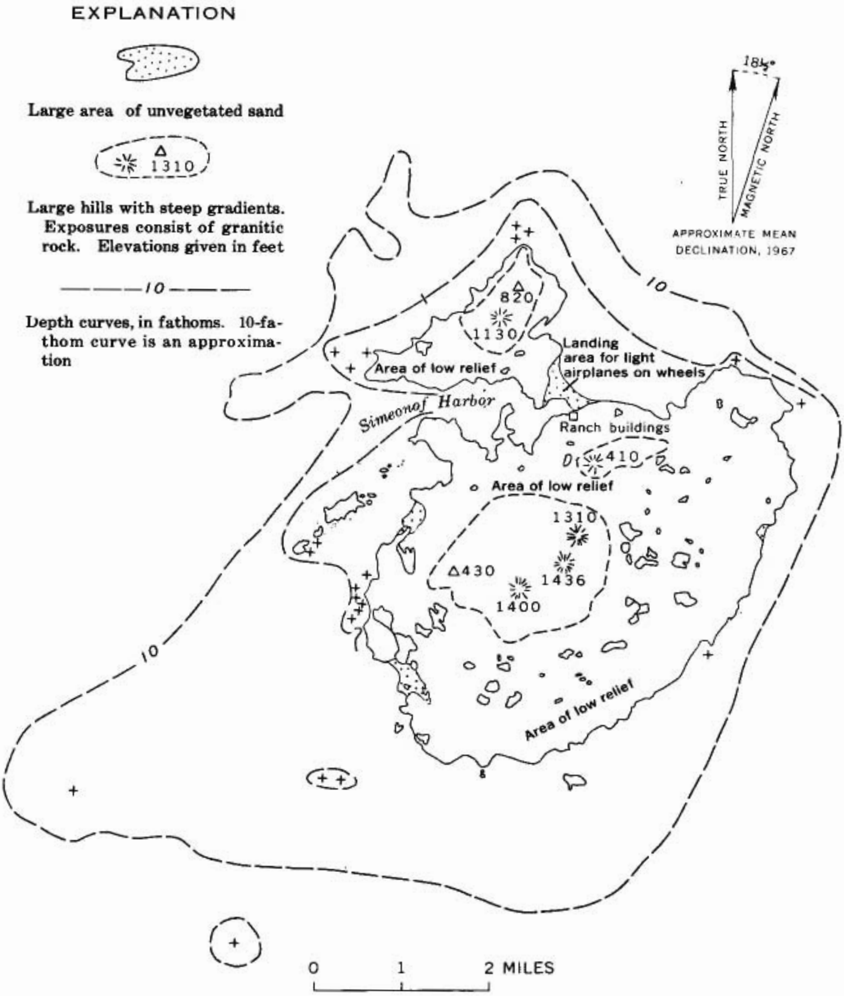


FIGURE 5.—Map of Simeonof National Wildlife Refuge.

the Alaska Peninsula between the Shumagin Islands and Kodiak Island (fig. 1). The Semidi Islands are a group of seven small islands, several islets, and offshore reefs and ledges with a total area of about 15½ square miles (fig. 6). Like Simeonof Island, they are erosional remnants on the Shumagin-Kodiak Shelf. The islands, bounded by steep and practically unscalable cliffs, rise to elevations of from 345 to more than 1,000 feet (U.S. Coast and Geodetic Survey, 1964, p. 131–132). The islands are thought to have been discovered by Bering in 1741. Because sem is Russian for the numeral seven (Baker, 1906, p. 561), it seems probable that the name refers to the seven islands of the group.

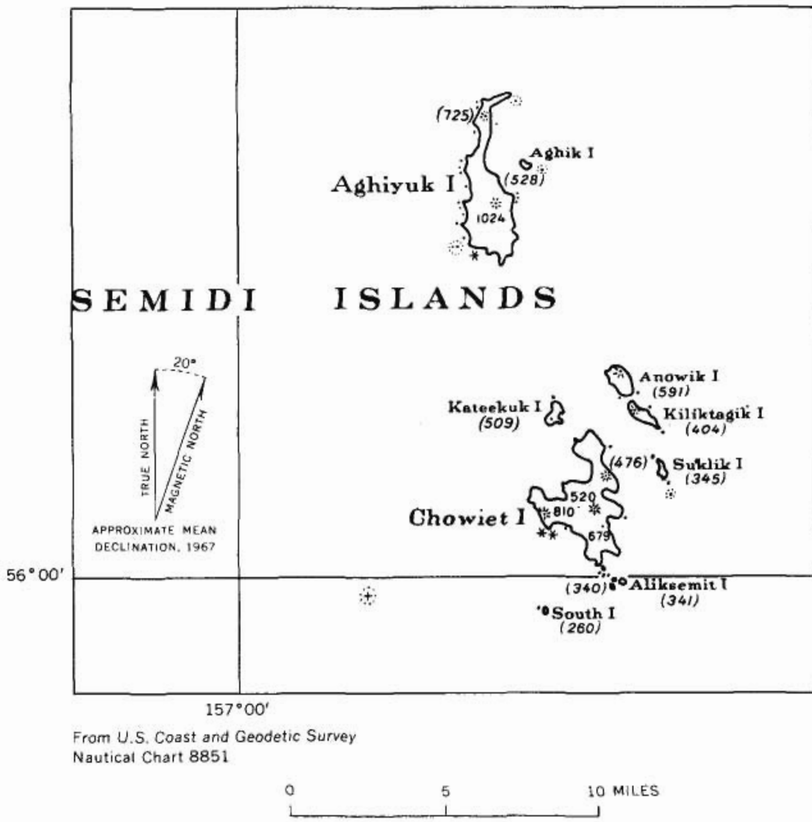


FIGURE 6.—Map of Semidi National Wildlife Refuge.

The islands are nearly inaccessible, but the U.S. Coast and Geodetic Survey (1964, p. 131) lists three anchorages in the group. The south-central part of Aghiyuk Island is a grassy plateau from which the highest point in the group rises. The ridges on Chowiet Island are covered with grass and alders (U.S. Coast and Geodetic Survey, 1964, p. 131).

GEOLOGY

A thick sequence of dark-gray graywacke sandstone, black argillite and slate, and some conglomerate underlies a large part of the extensive Shumagin-Kodiak Shelf, including much of the outer Shumagin Islands and the Kodiak Island group. These rocks are part of the great "slate and graywacke belt" of coastal southern Alaska. They were named the Shumagin Formation by Burk (1965, p. 63–71) but have been variously called the Sunrise Series, the Valdez Group, and the Yakutat Group where they extend into the Kenai- Chugach-St. Elias Mountains of south-central Alaska. These rocks are intruded by

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many granitic plutons, one of which, the Shumagin batholith, is at least 30 miles in diameter and underlies Simeonof Island (Burk, 1965, p. 110; Grantz, 1963, p. B108). Another underlies the Semidi Islands (Burk, 1965, pt. 3). Fossils collected from Burk's Shumagin Formation on Nagai Island in the Shumagin group include an *Inoceramus*, which defines the age of the rocks only as Jurassic or Cretaceous (Burk, 1965, p. 66). On the basis of lithologic evidence, however, Burk (1965, p. 68) speculates that his Shumagin Formation may be of middle to Late Cretaceous age. Potassium-argon ages indicate that the Shumagin batholith, which intrudes the Shumagin Formation, is Paleocene (Burk, 1965, p. 110).

Plutonic rocks make up Simeonof and neighboring islands. Four samples are light-gray medium-grained biotite granodiorite; a fifth sample, from southern Nagai, is biotite adamellite, a closely related rock (Grantz, 1963, p. B108). The Semidi Islands consist entirely of biotite granodiorite with the possible exception of what may be argillaceous material in a shear zone on Aghiyuk Island (Burk, 1965, p. 110). On Simeonof Island, bedrock beneath the lake-dotted surface of low relief, a wave-cut platform, is overlain by unconsolidated deposits of variable thickness. In a few places, the thickness of these deposits probably exceeds a few tens of feet. In two places that were visited deposits consist of beach and windblown sand, but features observed on aerial photographs suggest that in other places they consist of glacially deposited material (D. M. Hopkins and D. S. McCulloch, oral commun., 1962). Other unconsolidated deposits are small areas of alluvium and colluvium next to steep-sided hills, inactive vegetation-covered sand dunes, and bare beach sand and active sand dunes. Examination of aerial photographs suggests that the small amount of unconsolidated material on the Semidi Islands consists mainly of thin soil and windblown material, a narrow steep beach at the head of a bight on the east coast of Aghiyuk Island, and a little bare sand at the head of small inlets.

MINERAL RESOURCES

No deposits of minerals subject to leasing under the mineral leasing laws have been found in or near the areas embraced by the Simeonof and Semidi National Wildlife Refuges except for some lignitic coal that underlies an area of 35 or 40 square miles on Unga Island (Atwood, 1911, p. 117–120), the largest of the Shumagin group (fig. 4). These coal-bearing rocks are entirely absent from Simeonof and the Semidi Islands. The granitic rocks that make up Simeonof and the Semidi Islands and the rocks of Burk's Shumagin Formation which they intrude are types with which the minerals subject to the leasing laws are not associated. Lode deposits containing base and precious metals have been found in rocks correlative with the Shumagin Formation in other parts of Alaska and in volcanic rocks on Unga and Popof Islands (fig. 4) (Atwood, 1911, p. 125–127). Volcanic rocks, however, are not exposed on Simeonof or the Semidi Islands, so that similar lodes will not be found on them. A little gold has been recovered from beach placer deposits near Sand Point on Popof Island (Atwood, 1911, p. 125). Although it is not impossible that some of the sands on Simeonof Island might be auriferous, no gold placers have been reported, and the distance from source lodes would make their presence highly unlikely. Under certain economic conditions, such as accessibility and proximity to markets, granitic rocks can be valuable for dimension stone, riprap, road metal, and similar uses, but the isolation of the islands would preclude the development of such mineral resources in the Simeonof and Semidi Wildlife Refuges.

TUXEDNI NATIONAL WILDLIFE REFUGE

By Alexander A. Wanek

SUMMARY

Chisik Island, the site of the Tuxedni National Wildlife Refuge, is made up of sedimentary rocks of Jurassic age. Test wells drilled in the Tuxedni Group of rocks at Oil Bay, Dry Bay, and Fitz Creek about 40 miles southwest of Chisik Island have produced numerous oil and gas shows, but no commerical production. No test wells have been drilled on Chisik Island, but the absence of favorable structures and the fact that possible reservoir rocks are near the surface are not favorable indications for potential petroleum. No mineral deposits are known on the refuge and there is no record of mineral production.

INTRODUCTION

The Tuxedni National Wildlife Refuge includes all of Chisik Island, which is located at the mouth of Tuxedni Bay on the west side of Cook Inlet about 120 miles southwest of Anchorage, Alaska (fig. 1). Chisik Island is roughly wedge shaped and has an area of approximately 9 square miles. It is 6½ miles long and about 2¼ miles wide across the north part of the island but narrows to less than one-fourth mile at its southernmost point. Tuxedni Bay is very shallow except for Tuxedni Channel which separates Chisik Island from the mainland approximately ½ to 2 miles away. Most of Tuxedni Bay is dry at low tide, and even at high tide much of the bay is shallow. High winds and tricky tidal currents at the head of Tuxedni Bay make landing in the area by seaplane or boats quite hazardous. During the salmon season, a cannery, the Snug Harbor Packing Co., is in operation in the southern part of Chisik Island, where a safe harbor is available. There are no roads on the island except within the cannery site. A large colony of black-legged kittiwake and associated seafowl nest on Chisik Island.

The mainland adjacent to the tidal flats of Tuxedni Bay is very rugged, and the slopes are generally steep, usually rising rapidly to peaks at elevations about 2,000 feet. Iliamna Volcano and Redoubt Volcano at elevations of 10,016 feet and 10,197 feet, respectively, have been active in historic time and are within 15 miles of Tuxedni Bay. Large glaciers are within a few miles of tidewater.

The topography of Chisik Island is rugged and the highest point is at an elevation of 2,674 feet in the north part of the island. From this point the land surface dips southward gradually along a narrow ridge to the south end of the island. On the east side and west side of Chisik Island, the slopes are steep and rise abruptly from the tideflats to the crest of the ridge. All streams are short and flow in precipitous courses.

Some spruce timber grows in a few small isolated areas on Chisik Island. Cottonwood trees are more widespread and grow to a large size along stream courses near tidewater. A heavy growth of alders covers the slopes to an elevation of about 2,000 feet. Redtop grass is abundant in the open area where it grows to 4 and 5 feet in height in the summer months. Berry bushes and other small shrubs are also common.

GEOLOGY

The earliest investigations in this area were made at Oil Bay by Martin (1905) in his studies of the petroleum possibilities of the area. Stanton and Martin (1905) studied the geology of the west side of Cook Inlet and the Alaska Peninsula, and much of this work is used as the basis for the Jurassic stratigraphy in south-central Alaska. Martin and Katz (1912) made field studies in the Iliamna region and described the stratigraphic sections measured by Stanton and Martin between Tuxedni Bay and Iniskin Bay. Moffit (1922) and C. P. McKinley made a geologic and topographic reconnaissance in the vicinity of Tuxedni Bay. Moffit (1927) made a comprehensive study of the geology between Iniskin Bay and Chinitna Bay and of part of the Tuxedni Bay area. Kirschner and Minard (1949) made an oil and gas investigation of the Iniskin Peninsula. Hartsock (1954) made geologic studies of the Iniskin Peninsula from 1948–51 and was the first to recognize the presence of a quartz monzonite stock in the Aleutian Range batholith. Juhle (1955) made a geologic study of Iliamna Volcano and its basement. Grantz (1956) studied the magnetite deposits of Tuxedni Bay. Detterman (1963), Detterman and Reed (1964), and Detterman and Hartsock (1966) made a regional study of the stratigraphy, structure, and mineral resources of the Iliamna Lake region. The present report summarizes the work of the previous writers in evaluating the mineral resources of Chisik Island. No field observations were made by the present writer in preparing this report.

Marine sedimentary and volcanic rocks of Mesozoic age underlie the Tuxedni Bay area. They are intruded by granitic rocks of the Aleutian Range batholith of Early Jurassic to early Middle Jurassic age (Detterman and others, 1965). Continental sedimentary rocks of Tertiary age are north and south of Tuxedni Bay, and basaltic andesite of middle to late Tertiary age crops out on the north and west shore of Tuxedni Bay. Most structures in the bedded rocks strike northeast and conform with the regional strike of the Bruin Bay fault and less closely with the east border of the batholith. The magnetite deposits at localities at the head of Tuxedni Bay occur along this structural trend and in the replacement zones in the marble and volcanic host rocks (Grantz, 1956).

The exposed rocks on Chisik Island are about 4,800 feet thick (Detterman, 1963; Detterman and Hartsock, 1966) and range from Middle (?) Jurassic to Late Jurassic in age (fig. 7). They are chiefly marine arkosic sandstone, conglomerate, siltstone, and shale. The descriptions of rocks are generalized from published stratigraphic sections at localities on Chisik Island and the adjacent mainland.

The oldest rocks crop out in a small area at the northwest end of Chisik Island and consist of less than 100 feet of siltstone and sandstone assigned to the Middle (?) and Upper Jurassic Bowser Formation of the Tuxedni Group (Detterman, 1963). Detterman measured 1,830 feet of the Bowser Formation along Bowser Creek on the Iniskin Peninsula and described these rocks as part of a thick sequence of graywacke, conglomerate, siltstone, and shale about 10,000 feet thick which overlies Lower Jurassic volcanic tuff and breccia. Juhle (1955) stated that an erosional unconformity locally separated these rocks from the overlying siltstone beds of the Chinitna Formation, and a channel conglomerate at the base of the Chinitna Formation on Chisik Island supports his findings.

The Chinitna Formation, of Late Jurassic age (Martin and Katz, 1912; Kirschner and Minard, 1949), crops out extensively on the north and west sides of Chisik Island. It is a slope-forming sequence of rocks, approximately 1,850 feet thick, which consists predominantly of dark thick-bedded siltstone interbedded with thin calcareous sandstone beds and zones of fossiliferous concretions (Juhle, 1955). The top of the Chinitna Formation is overlain unconformably by coarse conglomerate beds of the Chisik Conglomerate Member of the Naknek Formation.

The Naknek Formation, of Late Jurassic age (Spurr, 1900), consists of approximately 2,800 feet of arkosic sandstone, conglomerate, and

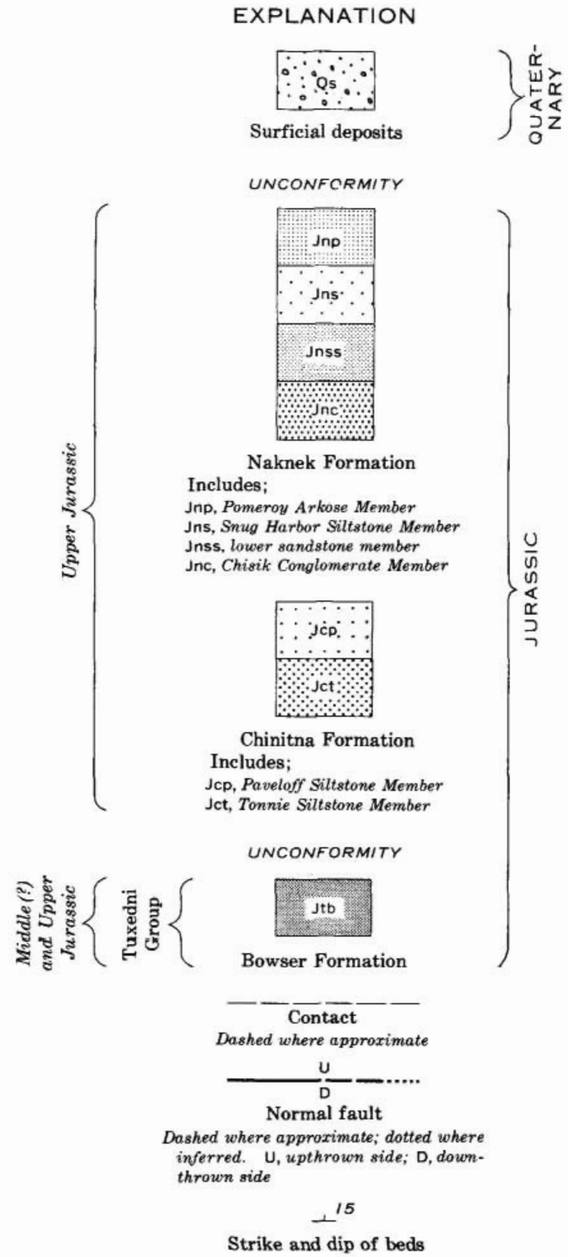
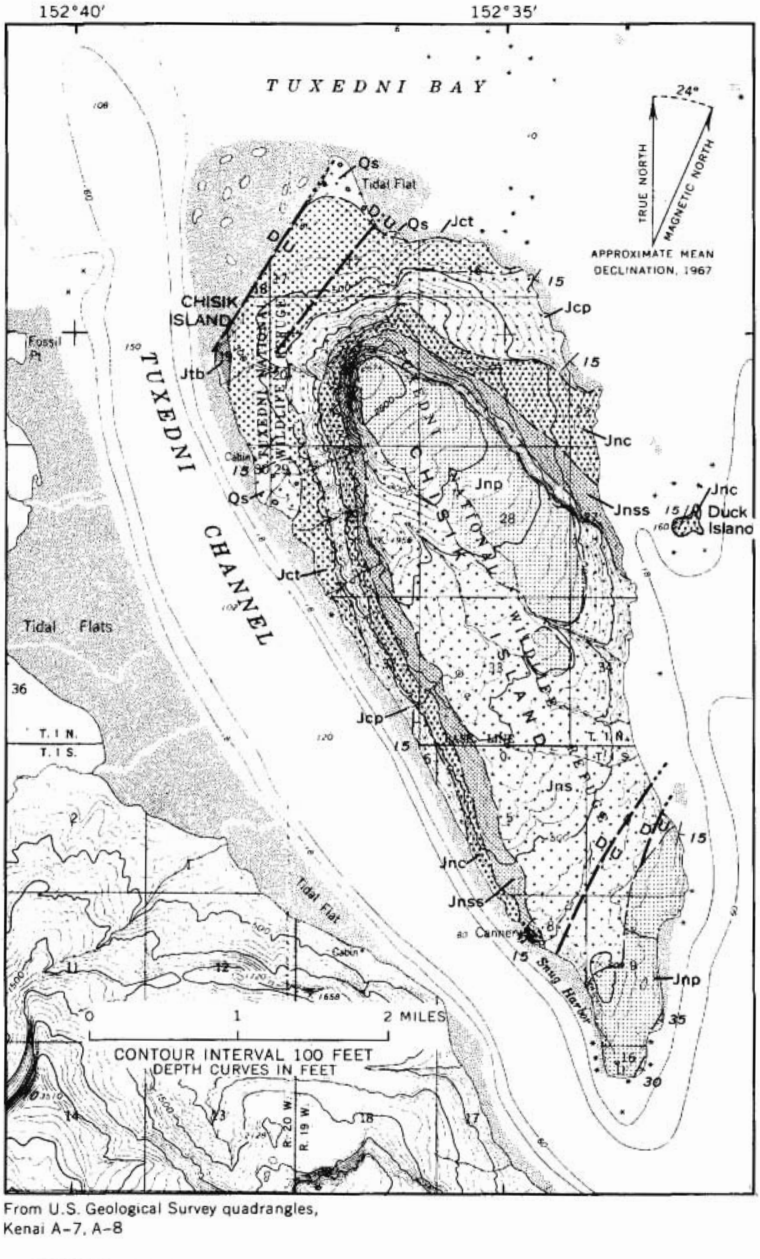


FIGURE 7.—Geologic map of Chisik Island, Tuxedni National



Wildlife Refuge. From Detterman and Hartsock (1966).

shale that are exposed on Chisik Island. As the result of recent mapping by Detterman (in Detterman and Hartsock, 1966), the formation has been subdivided in ascending order into the Chisik Conglomerate Member, about 560 feet thick; a lower sandstone member, about 530 feet thick; the Snug Harbor Siltstone Member, about 860 feet thick; and the Pomeroy Arkose Member about 840 feet thick. The contacts between the members of the Naknek Formation are conformable and gradational. The Chisik Conglomerate Member consists of coarse massive conglomerate which forms conspicuous cliffs on the north and west side of Chisik Island. The upper part of the Naknek Formation exposed along the southern part of Chisik Island consists of cliff-forming interbeds of hard arkosic sandstone, conglomerate, and shale of the Pomeroy Arkose Member. Fossils are not abundant in the upper part but are fairly common in the lower sandstone member and Snug Harbor Siltstone Member. They have conclusively indicated a Late Jurassic age.

The geologic structure in the vicinity of Tuxedni Bay is generally a southeast-dipping homocline which appears to trend northeast parallel to the large Bruin Bay fault near Chinitna Bay. Faulting is fairly common on Chisik Island, but the displacement on the faults is not great (Detterman and Hartsock, 1966). The attitudes of the rocks are steep near the head of Tuxedni Bay but flatten toward the coastline. In the north part of Chisik Island, the rocks dip 15° SE but appear to dip 30°–35° SE near faults in the southern part of the island.

MINERAL RESOURCES

Oil and gas seeps in Mesozoic rocks on the Iniskin Peninsula led to the drilling of eight wells at Oil Bay and Dry Bay between 1898 and 1903. The recent wells were drilled on the southwest flank of the Fitz Creek anticline, and numerous shows of oil and gas were reported in test wells penetrating rocks of the Tuxedni Group. The deepest well, Antonio Zappa 1 in sec. 8, T. 5 S., R. 23 W., Seward meridian, was drilled by Alaska Consolidated Oil Co. in 1961 to a total depth of 11,231 feet. There has been no commercial production from wells in this area.

The same sequence of rocks that is exposed on the Iniskin Peninsula is present on Chisik Island. Earlier investigations indicated that the most favorable source rocks are in strata of Early Triassic age, and reservoir rocks are in strata of the Tuxedni Group of Middle and Late Jurassic age. In the vicinity of Tuxedni Bay, most of the reservoir rocks are exposed at the surface, and the possibility of oil and gas accumulation is not likely. However, changes in facies, permeability, and thickness in the strata of the Tuxedni Group could possibly form stratigraphic traps at depth.

On Chisik Island the south-dipping homocline is cut by minor faults. The fault displacements in the bedded rocks might be sufficient to cause oil and gas accumulation in possible structural traps. However, deep-seated intrusions, such as the Aleutian Range batholith of Early Jurassic to early Middle Jurassic age, and mafic intrusive bodies associated with the Tertiary and Quaternary volcanic rocks in this part of Cook Inlet are considered unfavorable for the accumulation of petroleum in the area. The lack of adequate structures also makes petroleum possibilities on Chisik Island unfavorable.

Coal is not present in the rocks of Mesozoic age in the vicinity of Tuxedni Bay. The coal-bearing Kenai Formation of Tertiary age crops out north and south of Tuxedni Bay and underlies Cook Inlet, but these coal-bearing rocks do not occur on Chisik Island.

The only known mineral deposits near Tuxedni Bay are magnetite deposits described by Grantz (1956). A large quartz diorite batholith crops out within 1,000 feet of the deposits and probably underlies them at shallow depth. The quartz diorite has an iron content of about 6 percent, and the magnetite deposits are probably genetically related to it. Grantz estimated that the magnetite content in the eastern part of the deposit is about 10 to 20 percent and in the western part is as much as 50 percent.

In summary, available data indicate a poor potential for oil and gas and no potential for coal on Chisik Island. The closest known occurrence of mineral deposits is at the head of Tuxedni Bay about 9¼ miles from the refuge. According to the records of the U.S. Geological Survey, no other mineral deposits or occurrences of mineralization have been reported in the area under consideration.

ST. LAZARIA NATIONAL WILDLIFE REFUGE

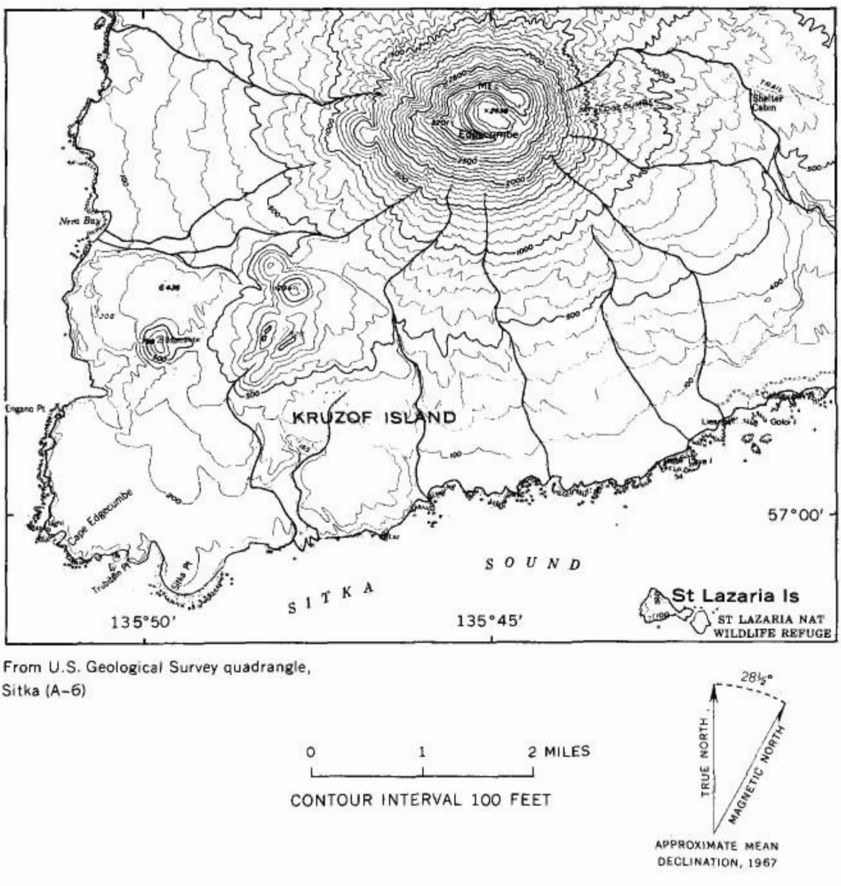
By Edward H. Cobb

SUMMARY

The two islands that compose the St. Lazaria National Wildlife Refuge are made up of Quaternary volcanic rocks and contain no deposits of minerals subject to leasing under the mineral leasing laws or to location.

INTRODUCTION

The two small islands that constitute the St. Lazaria National Wildlife Refuge are near lat 57° N. and long 135° W. in Sitka Sound about a mile off the south coast of Kruzof Island and about 15 miles west-southwest of Sitka, one of the major population centers of southeastern Alaska (fig. 1). In 1787, Capt. George Dixon called the islands Robin Island, but St. Lazaria, applied by Ivan Vasiliev in 1809, is the name that has been commonly used (Baker, 1906, p. 543). Considered as a unit, the islands (fig. 8) are about 3,500 feet long and up to 1,500 feet wide, with an area of about 75 acres. Maximum elevations on both islands are more than 100 but less than 200 feet. Most of the land above high-tide line is forested. Except for a reef extending about 375 feet off the northeastern point of the eastern island, deep water is close inshore around the islands. Small craft can anchor close inshore north of St. Lazaria and be protected during moderate storms from the south (U.S. Coast and Geodetic Survey, 1962, p. 158). The buildings on the western island (fig. 8) appear on the map (printed in 1956) that was used as a base for this figure but were not seen when geologists visited the islands in 1961. The buildings were probably part of World



From U.S. Geological Survey quadrangle, Sitka (A–6)

FIGURE 8.—Map of St. Lazaria National Wildlife Refuge and adjacent parts of Kruzof Island.

War II military installations that have been abandoned for many years (R. A. Loney, oral commun., Aug. 24, 1966).

GEOLOGY

Rocks of the Edgecumbe Volcanics, of Quaternary age, make up the St. Lazaria Islands. Basalt flows extruded from several vents on southern Kruzof Island, less abundant tuff breccia, ash, and lapilli deposits, and silicic plugs compose the Edgecumbe Volcanics (Loney and others, 1964). Mount Edgecumbe, a 3,201-foot cone that was one of the vents, is about 5 miles north-northwest of St. Lazaria (fig. 8). A soil cover sufficiently thick to support large coniferous trees has developed on parts of the islands.

MINERAL RESOURCES

No deposits of minerals subject to leasing under the mineral leasing laws or to location are known in the St. Lazaria National Wildlife Refuge or in neighboring areas underlain by the Edgecumbe Volcanics. Use of the volcanic rocks of which the islands are composed as construction materials seems extremely unlikely, as similar rocks on Kruzof Island and at other localities are much more accessible.

HAZY ISLANDS NATIONAL WILDLIFE REFUGE

By Edward H. Cobb

SUMMARY

The Hazy Islands National Wildlife Refuge consists of a few offshore rocks and five small islets with a total land area of not more than 100 acres. The one islet that has been visited by a geologist is made up, at least in part, of calcareous sandstone, clastic limestone, and hornfels. No deposits of minerals subject to leasing under the mineral leasing laws or to location have been reported from the Hazy Islands.

INTRODUCTION

The Hazy Islands National Wildlife Refuge is near lat 55°52′ N. and long 134°35′ W. in the North Pacific Ocean off the mouth of Chatham Strait and about 120 miles west-northwest of Ketchikan, the nearest city (fig. 1). The islets that make up the refuge (fig. 9) rise from a shelf that extends out from Coronation Island, which lies about 8 miles east. The Hazy Islands were named by early English fur traders in the 18th century; the Russian name for them was Tumannoi, which means foggy (Baker, 1906, p. 301). They form two distinctive groups that are separated by a channel 1.2 miles wide and 25 to 40 fathoms deep. The northwestern group consists of three prominent islets, the largest of which, Big Hazy Islet, is conical in shape and about 200 feet high. The southeastern group is low and constitutes a hazard to naviga-

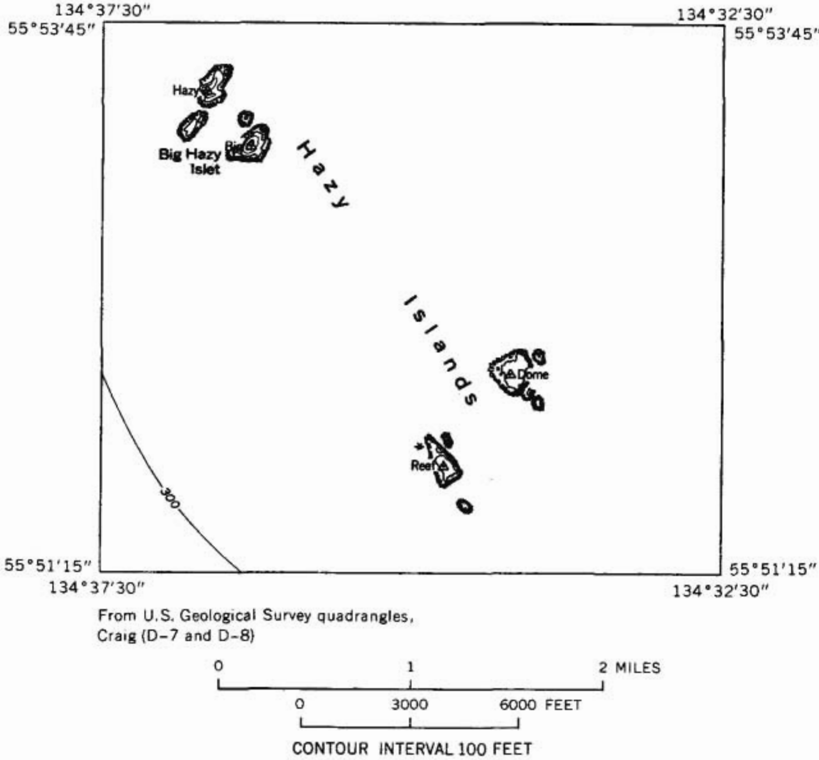


FIGURE 9.—Map of Hazy Islands National Wildlife Refuge.

tion in thick weather. The only vegetation reported in the refuge is grass on one of the islets of the southeastern group (U.S. Coast and Geodetic Survey, 1962, p. 134). In August 1963, when L. J. P. Muffler of the Geological Survey visited one of the islets, sea lions were so thick that they made landing hazardous (written commun., Aug. 19, 1966).

GEOLOGY

This section is based entirely on an informal memorandum describing a 30-minute visit by L. J. P. Muffler (written commun., Aug. 19, 1966) to the easternmost of the Hazy Islands, the islet on which triangulation station Dome is located (fig. 9), and on verbal discussions with him on August 23, 1966. When he visited the islet, the weather was such that he could see practically nothing but the ground where he landed on the northeast shore of the islet. The rocks he saw and of which he collected specimens that were later studied in the laboratory were:

60 percent: Thin-bedded to medium-bedded, medium-gray fine-grained

lithic calcareous sandstone with secondary pyrite (about 3 percent) and tremolite.

25 percent: Very thin bedded dark-gray impure, very fine grained clastic limestone, recrystallized to a microcrystalline texture; containing calcite (85 percent), quartz and plagioclase (10 percent), graphite(?), and secondary pyrite (2 percent) and amphibole (1 percent); and interbedded with the calcareous sandstone.

15 percent: Light-gray hornfels containing scapolite (65 percent), diopside (20 percent), calcite (5 percent), quartz, plagioclase, garnet, sphene, magnetite(?), and pyrite (along microfractures); the relationship of this rock to the limestone and sandstone was uncertain.

Although Muffler found no fossils, the submarine bank between Coronation Island and the Hazy Islands and the similarity of the rocks to Upper Silurian rocks on Kuiu Island (the next large island to the northeast) suggest to him that the Hazy Islands are related to the structural block of which Kuiu and Coronation Islands are parts rather than to the block of which Baranof Island (the large island north of the Hazy Islands) is the major part. If this is true, then the age of the rocks that make up the Hazy Islands is probably Paleozoic.

MINERAL RESOURCES

No minerals subject to leasing under the mineral leasing laws or to location have been found in the islets that make up the Hazy Islands refuge. The presence of scapolite, a mineral that occurs in rocks that have been either contact metamorphosed or regionally metamorphosed, suggests that deposits of minerals covered by the leasing laws do not exist on the Hazy Islands. Considering the size of the islets, any deposits of such minerals that might be found would probably be too small to mine. Deposits of base and precious metals, although not known from the Hazy Islands, might be discovered if the islets were examined in detail, especially in view of the pyrite found in Muffler's specimens. On neighboring Coronation Island more than 100 tons of lead ore is reported by Twenhofel, Reed, and Gates (1949, p. 38–40) to have been mined and shipped from small lenticular bodies in fault zones. They concluded that, even though there are probably other ore bodies in the fault zones, "their value probably would not be commensurate with the effort needed to find them." In view of this statement and of the small size and inaccessibility of the Hazy Islands, it is highly unlikely that deposits of economic interest will be found in the refuge.

FORRESTER ISLAND NATIONAL WILDLIFE REFUGE

By EDWARD H. COBB

SUMMARY

The islands and rocks in the Forrester Island National Wildlife Refuge are made up mainly of granodiorite that has intruded conglomerate of possible Silurian age. No deposits of minerals subject to location or to leasing under the mineral leasing laws are known in the refuge.

INTRODUCTION

The uninhabited islands and offshore rocks that compose the Forrester Island National Wildlife Refuge (fig. 10) are in the Pacific Ocean near lat 54°50′ N. and long 133°30′ W. about 85 miles southwest of Ketchikan, the nearest city and supply point (fig. 1). The largest island in the group had been called by several names before Capt. George Dixon in 1787 named it Forrester, the name adopted by Capt. George Vancouver and used exclusively since at least as early as 1800 (Baker, 1906, p. 261). Lowrie Island, about a mile north of Forrester, was named by W. H. Dall in 1879 for Captain Lowrie, of the sailing vessel *Captain Cook*, who, in 1786, was possibly the first English-speaking navigator to see the island (Baker, 1906, p. 415). Wolf Rock, 13.5 miles north of the highest point on Forrester Island, is also part of the refuge, but is not shown on figure 10.

Forrester Island is about 5 miles long, nearly 1½ miles wide at its widest part, and has an area of about 4 square miles. The northern two-thirds of the island is a ridge with several distinctive wooded summits (U.S. Coast and Geodetic Survey, 1962, p. 70), the highest of which is 1,340 feet in elevation. Most of the rest of the island is a muskeg flat on a bench about 300 feet above sea level and surrounded by trees. A low knob rises above the flat on the east side and another forms the southernmost tip of the island. There are no roads, but a trail leads from Eagle Harbor on the east side of the island near its north end to an inactive military installation on the ridge crest. Lowrie and Petrel Islands, respectively north of and south of Forrester, are each less than 160 acres in area, about 250 feet high, and wooded. Grass grows on the tops of some of the offshore rocks that make up the rest of the refuge.

There are no secure anchorages off Forrester Island, but in summer small craft can anchor in four places, near one of which (Eagle Harbor) there is a small fresh-water stream (U.S. Coast and Geodetic Survey, 1962, p. 70).

Wolf Rock is a bare islet about 700 feet long and less than 300 feet wide with an area of about 3 acres and a maximum elevation of 30 feet. It is surrounded by foul ground for a distance of at least half a mile

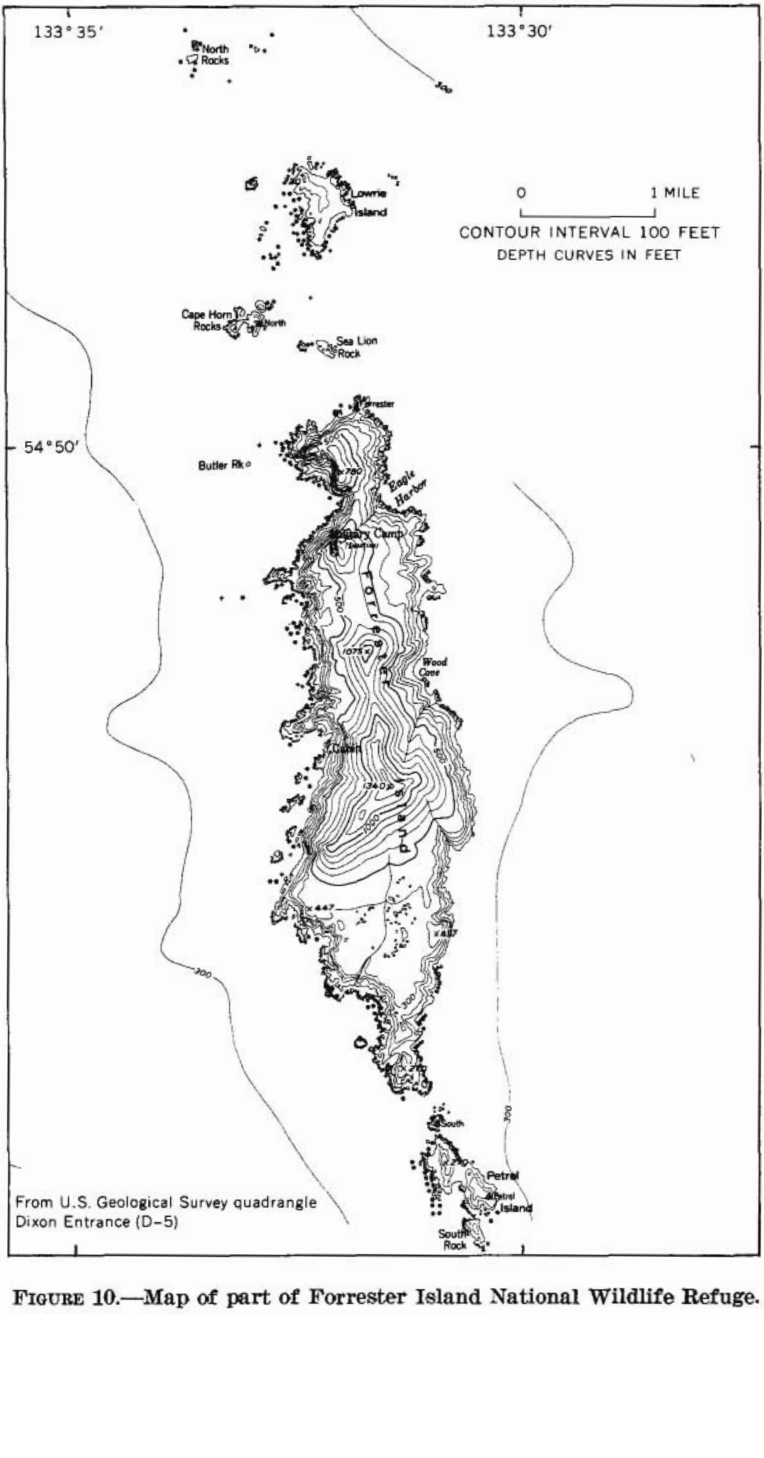


FIGURE 10.—Map of part of Forrester Island National Wildlife Refuge.

(U.S. Coast and Geodetic Survey, 1962, p. 70). The rock was called Forrester's Island by Capt. John Meares in 1788, Isla Rasa (flat island) by the Spaniards at about the same time, and was given its present name by Capt. George Vancouver in 1794 (Baker, 1906, p. 679).

GEOLOGY

Very little is known about the geology of Forrester and the adjacent islands. According to Buddington and Chapin (1929, p. 80): "On the northeast end of Forrester Island there is a narrow fringe of conglomerate of Silurian type bordering intrusive granodiorite." Their geologic map of southeastern Alaska (Buddington and Chapin, 1929, pl. 1) shows the rest of Forrester, and both Lowrie and Petrel Islands, as granodiorite of Late Jurassic or Early Cretaceous age. Study of aerial photographs suggests that the offshore rocks are also granitic. There appear to be very small beaches at the heads of some of the coves on the east shore of Forrester Island. Wolf Rock is not shown on any geologic map nor described in any geologic report available to the writer.

MINERAL RESOURCES

Deposits of minerals subject to leasing under the mineral leasing laws are never associated with granitic rocks. Although deposits of some of the minerals subject to leasing could occur in conglomerate, metamorphism attendant on the emplacement of the granodiorite pluton that makes up most of Forrester and the adjoining islands probably would have destroyed any such deposits that might originally have been in the narrow fringe of sedimentary rocks on the northeast part of Forrester Island. Deposits of minerals subject to location are frequently found in contact zones around granitic plutons, but none has been reported from the contact zone on the northeastern part of Forrester Island. As this is the most accessible place in the refuge and as it is near the trail to the abandoned military installation on the island, any significant mineral deposit probably would have been noticed and reported. Isolation precludes any but local use of the granitic rocks of the refuge as construction materials.

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