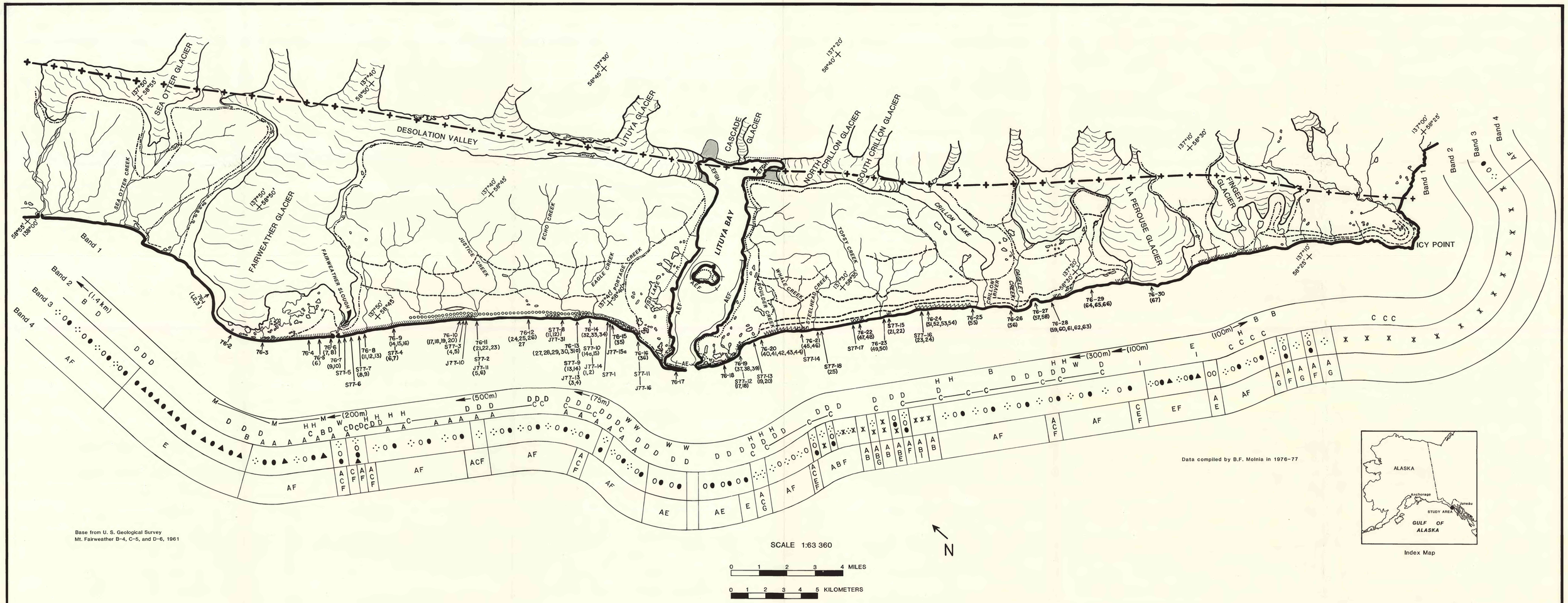
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE NATIONAL PARK SERVICE

MISCELLANEOUS FIELD STUDIES
MAP MF-1207



Data compiled by B.F. Molnia in 1976-77

Index Map

Base from U. S. Geological Survey
Mt. Fairweather B-4, C-5, and D-6, 1961

SCALE 1:63 360

0 1 2 3 4 MILES

0 1 2 3 4 5 KILOMETERS

TABLE 1 - Sediment Data

Sample Number	Percent Gravel	Percent Sand	Percent Silt	Percent Clay	Mean (ø)	Sorting
76-1	31.0	68.2	0	0	-0.5	-1.2	1.3
76-2	.2	99.8	0	0	.5	.9
76-3	4.4	95.6	0	0	.4	.8
76-4	48.2	51.8	0	0	-1.0	-0.8	1.4
76-5	0	100	0	0	1.0	1.0	.8
76-6	0	100	0	0	1.0	1.0	.9
76-7	0	100	0	0	1.0	1.0	.9
76-8	57.4	42.6	0	0	-1.5	-1.1	.7
76-9	12.3	87.6	0	.1	.6	.5	1.2
76-10	66.6	33.4	0	0	-1.6	-1.6	1.2
077-6	.6	99.4	0	0	1.0	1.0	.8
077-7	0.4	99.6	0	0	1.0	1.0	.8
077-10	0	100	0	0	1.0	1.0	.7
76-12	.2	99.8	0	0	1.0	1.0	.8
76-13	0	100	0	0	1.0	1.0	.8
76-14	26.9	73.1	0	0	1.4	.9	1.0
76-14	0	99.7	.1	.2	2.0	2.0	.5
76-15	0	100	0	0	2.0	2.0	.5
76-16	0	100	0	0	1.0	1.0	.7
076-16	16.8	83.2	0	0	1.0	1.0	.8
077-7	100	0	0	0	-4.2	-4.1	1.4
76-17	0	100	0	0	1.1	1.1	.8
76-18	0	100	0	0	1.0	1.0	.8
76-19	100	0	0	0	-2.5	-2.5	.5
76-20	23.8	76.2	0	0	.8	.5	1.6
077-4	3.9	96.1	0	0	.7	.6	.9
077-5	46.2	53.8	0	0	-0.9	-0.2	1.4
76-21	0	100	0	0	1.0	1.0	.8
76-22	20.9	69.1	0	0	-0.7	-0.8	1.0
76-23	66.3	33.7	0	0	-1.1	-1.0	.3
076-23	0	100	0	0	1.0	1.0	.8
077-1	65.3	34.7	0	0	-1.1	-1.1	.3
077-1	0	100	0	0	1.0	1.0	.6
077-2	6.8	92.1	.2	.9	1.0	1.1	1.0
077-3	50.1	49.9	0	0	-1.0	-0.9	.3
76-24	1.2	98.8	0.0	0	1.0	1.0	.8
76-25	25.2	74.8	0	0	-0.1	-.1	.9
76-26	39.6	60.4	0	0	-0.9	-0.9	.3
076-26	0	100	0	0	1.0	1.0	.8
76-28	0	100	0	0	1.1	1.1	.8
76-29	0	100	0	0	1.0	1.1	.6
76-30	28.4	71.6	0	0	-0.2	-0.1	1.4
76-31	12.6	87.4	0	0	.3	.3	1.0
076-31	0	100	0	0	1.0	1.0	.8
077-14	7.5	92.5	0	0	.9	.9	.7
077-13	0	100	0	0	1.9	1.9	.5
077-12	1.4	98.6	.1	.1	2.0	2.0	2.0
077-11	1.4	98.6	.1	1.0	1.0	1.0	.7
077-12	60.2	31.0	0	0	-2.1	-2.0	2.2
76-32	0	99.8	.1	.1	2.1	2.1	.5
76-33	0	100	0	0	2.0	2.0	.5
076-33	0	100	0	0	1.0	1.0	.8
077-4	0	100	0	0	1.0	1.0	.5
077-1	.1	99.9	0	0	1.4	1.5	.5
077-15	0	100	0	0	1.0	1.0	.8
76-35	0	100	0	0	-1.3	-1.4	1.4
76-34	66.2	33.8	0	0	-1.1	-1.1	.6
76-36	0	100	0	0	1.3	1.3	.7
76-38	1.4	98.6	0	0	1.0	.8	.8
076-38	0	100	0	0	1.0	1.0	.8
077-17	.9	99.1	0	0	.9	.9	.8
077-18	4.5	95.3	.1	1.1	1.2	1.2	.7
077-19	1.4	98.6	.1	.1	2.0	2.0	.5
077-20	1.5	98.5	0	0	1.1	1.1	.8
76-40	0	100	0	0	1.7	1.7	.5
76-41	0.	100	0	0	2.0	2.0	.4
76-42	5.3	94.7	0	0	1.1	1.1	.7
76-43	2.6	97.4	0	0	1.0	1.0	.8
76-44	2.6	97.4	0	0	.9	.9	.7
76-46	97.6	2.3	.1	0	-2.2	-2.3	.6
077-20	3.1	96.9	0	0	.9	.9	.7
76-48	.7	99.3	.1	.1	1.1	1.1	.9
76-49	2.2	92.1	5.0	.8	.3	.5	1.3
76-50	3.9	96.1	0	0	.2	.3	.8
077-21	0	100	0	0	2.2	2.3	.4
077-22	1.1	98.9	0	0	1.0	1.0	.8
077-23	.3	99.7	0	.1	1.1	1.0	.9
077-24	82.9	17.1	0	0	-2.0	-3.0	2.0
76-51	0	100	.1	.1	1.1	1.1	1.0
76-52	0	100	0	0	2.3	2.3	.5
76-53	0	99.9	0	.1	2.1	2.1	.3
76-54	46.3	53.7	0	0	1.0	-0.2	3.7
76-55	0	100	0	0	1.0	1.0	.4
76-56	0	100	0	0	1.0	1.0	.8
76-57	0	100	0	0	1.0	1.0	.5
76-58	99.7	.3	0	0	-2.2	-2.4	.8
76-59	0	100	0	0	1.0	1.0	.8
76-61	1.9	98.1	0	0	.9	.9	.5
76-62	0	100	0	0	.4	.5	.8
76-63	0	100	0	0	1.4	1.4	.5
76-64	0	100	0	0	1.6	1.5	.6
76-65	18.0	82.0	0	0	.1	.2	1.4
76-66	.3	99.8	0	0	.8	.9	.5
76-67	0	99.4	.3	.3	1.9	1.9	.6

Introduction

This map summarizes the results of a three-year field and laboratory study designed to characterize the beach environment and the susceptibility to oil spills of the Gulf of Alaska coastal area of Glacier Bay National Monument. The study was funded by the National Park Service, Department of the U.S. National Park Service. The study Molnia and Wheeler, 1978) consisted of winter and summer field measurements of beach morphology and composition, nearshore bathymetry, and coastal processes, interpretation of aerial photographs and maps, and synthesis of published geologic literature. Criteria for the evaluation of the potential effects of an oil spill on the beach area were also developed by modifying published schemes of Hayes, Brown, and Kinkel (1976) and Owens (1977).

Delineation of the Map

Data pertaining to this coastal area are presented as a series of symbols on the land area of the map and in four offshore bands parallel to the coastline. The symbols in the bands pertain to the beach segment bounded by the vertical lines projected from the bands to the shore.

The onshore data depict the location of glacial moraines, the base of raised sea cliffs, the location of the Fairweather fault, the position of uplifted beach ridges or bars that pond water, the location and height of Fairweather fault scarps that impound ponds, the moraine and rockslide scar from the 1958 giant wave (Miller, 1960), and the location of deltas at the head of Lituya Bay. Susceptibilities to oil spills of the beaches plotted in the onshore area: the symbols are discussed in the explanation for band 4.

Band 1

Band 1 depicts the location of sediment samples and the location of profile sites. Samples were collected from the top 10 cm of beach at 1-5 locations along each beach profile. Sediment samples from the beach face were recovered in waterproof bags. Laboratory analyses were made of grain size using rapid sediment analyzers and hydrophotometers.

Sediment size data are presented in Table 1. On this map sample numbers are shown in parentheses under the profile station number at which they were collected. These separate profiles: 76, 077, and 077, are used to delineate individual zones of profile and sample collection. The profiles correspond, respectively, to the three profiles in Molnia and Wheeler (1978) and numbers in Table 1 are preceded by one of the three prefixes. Profiles are not presented with this map but are given in Molnia and Wheeler (1978).

Band 2

Band 2 displays data about beach morphology, beach composition, and erosional state of beach-beach scarps using a series of capital letters as symbols. In addition, the direction and distance of stream offset are shown by a separate symbol.

Data displayed in band 2 include:

A - Areas of active erosion where from 1-3 m of erosion of the beach-beach scarp were measured during the period covered by field surveys.

B - Areas subject to glacial late breakout floods. Post and Mayo (1971) identify Lituya Glacier and Finger Glacier as potential sources of glacial lake breakout floods. Other glaciers, Fairweather, Reliance, and Sea Otter Glacier as possible flood sources.

C - Beaches with cusps. Many beach segments had well-developed cusps and sets of cusps. In the vicinity of Depoint and Crillon Rivers, many beaches had multiple cusps, many as high as 2 m.

D - Abundant storm-deposited debris. Near Fairweather Slough, the maximum height of storm-deposited debris was 3 m, but it was usually less than one meter. Forty miles in the Gulf of Alaska coastal area of Glacier Bay National Monument had storm-deposited debris at elevations that averaged greater than 8.0 m above MLLW.

E - Eskers.

F - Heavy mineral concentrations. Many beach profile sites and adjacent nearshore areas in Glacier Bay Baseline Code were greater than 75 percent heavy minerals. Garnet was the most common heavy mineral seen.

I - Ice-cored beaches.

M - Ice-cored moraines.

W - Washover deposits and fans.

Band 3

Band 3 contains symbols that indicate the grain size of the material making up the beach. Except for areas of mudflat and flight in sheltered sections of Lituya Bay, all the beach sediment observed is coarser than fine sand size. Symbols depict sand, pebbles, cobbles, boulders, and bedrock outcrops. Sediment parameters of samples collected from the beaches are presented in Table 1.

Band 4

Band 4 presents a classification of the susceptibility of the beach to be damaged by oil, presented in terms of the length of time oil will remain in the beach. The longer the contact oil has with the sediment, the greater the probability of biological and environmental damage.

Nine designations (A-I) are used to indicate susceptibility. A is the highest rating, because it represents a beach with a low energy environment in which oil is retained in the environment. The longer the oil is retained, the higher the rating. Long-term exposure to oil commonly causes biological damage. Below, areas where oil would be quickly dispersed by natural processes or easily recovered by clean-up operations are given low ratings. Beaches composed of coarse sediment are given low ratings because circulation through the sediment are dated highest. This sequence of designations includes environments not found in the study areas of Hayes, Brown, and Kinkel (1976) and Owens (1977) because they are not found on the coast in the Gulf of Alaska study area. Multiple component beaches have multiple susceptibility designations: a gravel beach with an upper vegetated beach meadow is designated AE. Higher level vegetated beach meadows and forest are included in this classification because at almost all of the profile sites, the vegetation was observed growing on beach sediment and the beach ridge stems were higher than the lowest shoaled vegetation. Hence, if an oil spill were to occur during a storm, perhaps the most probable time, then store waves would deposit the oil on the beach, which would easily deposit oil above the limit of the modern storm-beach. Many species by which could easily deposit oil in the forest or on the vegetated beach ridge. Band 4 also presents data on lower tidal conditions. The bedrock platform with tidal pool environment is judged to have a much greater susceptibility to oil in this study than in the Hayes, Brown, and Kinkel (1976) study because the bedrock platforms in the Lituya Bay area are composed of fractured, jointed, hummocky Yakutage Formation and present a much greater surface area, with multiple places for pooling of oil, than platforms in the area studied by Hayes, Brown and Kinkel. Oil trapped in the joints and fractures may slowly be released to the environment. Thus, pool organisms may experience continuous long-period exposure to the oil.

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Miller, D.J., 1960, Giant waves in Lituya Bay, Alaska: U.S. Geological Survey Professional Paper 354-C, p. 51-86.

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Owens, E.H., 1977, Coastal environments of Canada: The impact and cleanup of oil spills: Economic and Technical Review Report EPS-3-EC-77-11, Canadian Environmental Protection Service Ottawa, Ontario, 411 p.

Post, Austin, and Mayo, L.R., 1971, Glacier dammed lakes and outburst floods in Alaska: U.S. Geological Survey Hydrologic Investigations Atlas HA-455.

EXPLANATION OF ONSHORE SYMBOLS

- Limit of moraines
- Base of raised sea cliff
- Fairweather fault (other faults not shown)
- Ponding barrier
- Backbeach scarp >3m in height (dashed where discontinuous)
- Backbeach scarp <3m in height (dashed where discontinuous)
- Delta
- 1958 rockslide scar
- Scourline from 1958 giant wave

EXPLANATION OF SYMBOLS CONTAINED WITHIN BANDS

Band 1
PROFILE STATIONS AND SAMPLES

- 76-6 Profile station location and number
- (7, 8) Samples collected at station

Band 2

- A Area of active erosion
- B Area subject to glacial-lake breakout floods
- C Beach with cusps
- D Abundant storm-deposited debris (debris common everywhere)
- E Esker
- H Heavy mineral concentrations
- I Ice-cored beach
- M Ice-cored moraine (onshore behind beach)
- W Washover deposits and fans
- ←(75m) Offset stream mouths (direction and distance)

Band 3
GRAIN SIZE OF BEACHES

- Sand
- Gravel:
  - Pebbles
  - Cobbles
  - Boulders
- Bedrock outcrop

Band 4
SUSCEPTIBILITY TO OIL SPILLS

Decreasing severity

- Highest
  - A Vegetated beach meadow
- Very High
  - B Bedrock platform with tidal pools
  - C Sloughs, backwaters, ponds
  - D Sheltered bedrock headland
  - E Gravel beach
  - F Sand and gravel beach
  - G Medium to coarse sand beach
- Moderate
  - H Fine sand beach
  - I Flat wave-cut platform

Note: No landward sequence is implied by the position of data in bands 1-4. All data pertain to the active beach and back-beach environment.

MAP SHOWING ENVIRONMENTAL GEOLOGY OF GULF OF ALASKA COASTAL AREA, GLACIER BAY NATIONAL MONUMENT

by

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1982

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