DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

OPEN FILE REPORT

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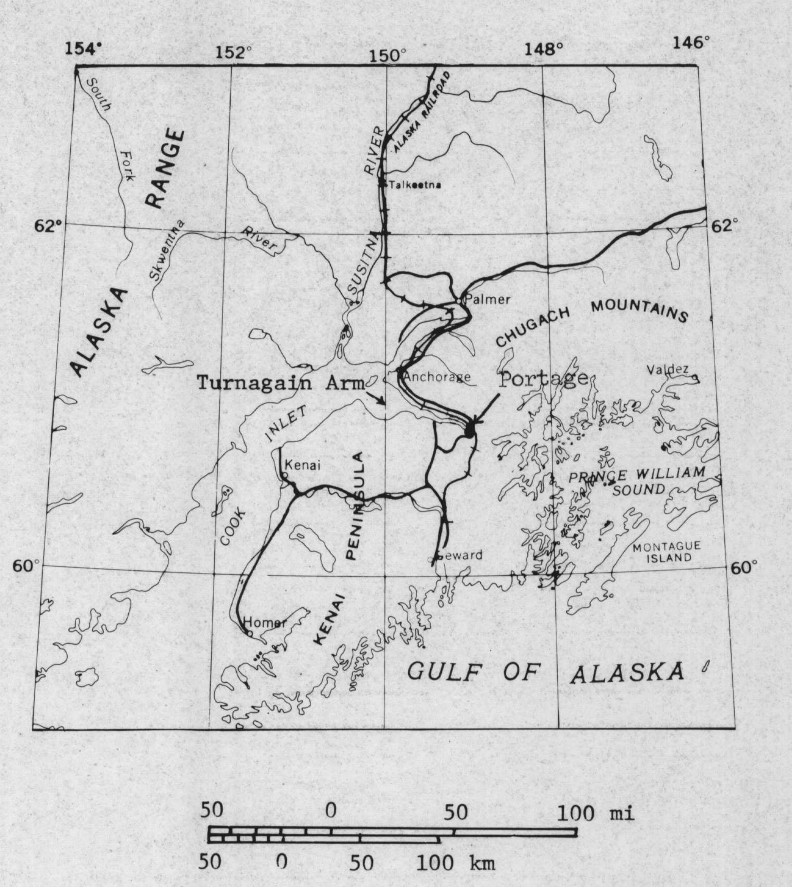

Figure 1. INDEX MAP OF THE COOK INLET REGION SHOWING THE LOCATION OF TURNAGAIN ARM. THE BLACK DOT INDICATES THE SITE OF THE ABANDONED VILLAGE OF PORTAGE.

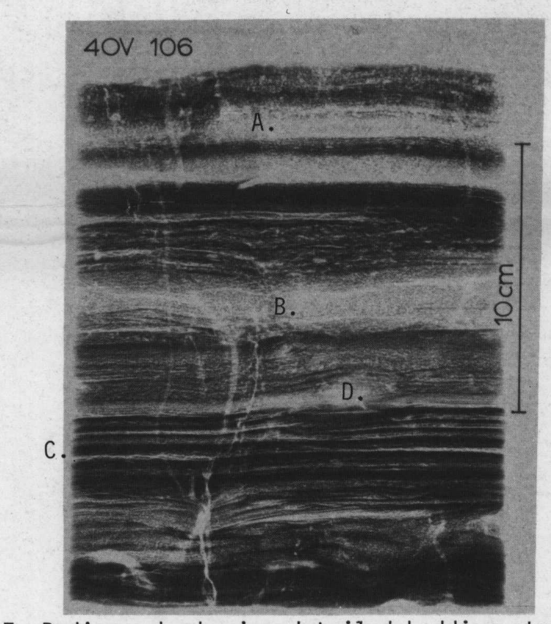

Figure 7. Radiograph showing detailed bedding structures in silt at Portage Flats: A. cavernous sand; B. plant rootlets; C. planar bedding; D. small-scale cross laminae.

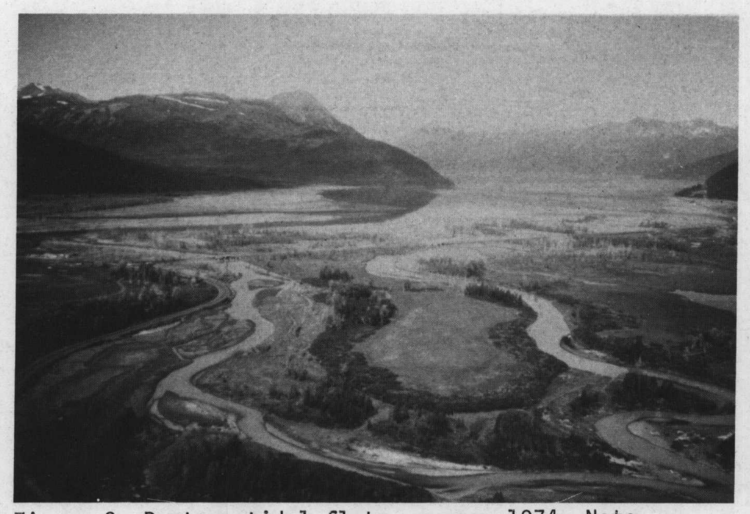

Figure 2. Portage tidal flats, summer 1974. Note the trees on the upper flat which were devastated by saltwater incursion after the 1964 earthquake.

Figure 8. Early spring 1975 scene on Portage Flats. Tidewater does not disturb snow and ice cover on the tidal flat, and is restricted to established tidal channels.

Figure 3. Aerial photograph of study area near Portage, Alaska.

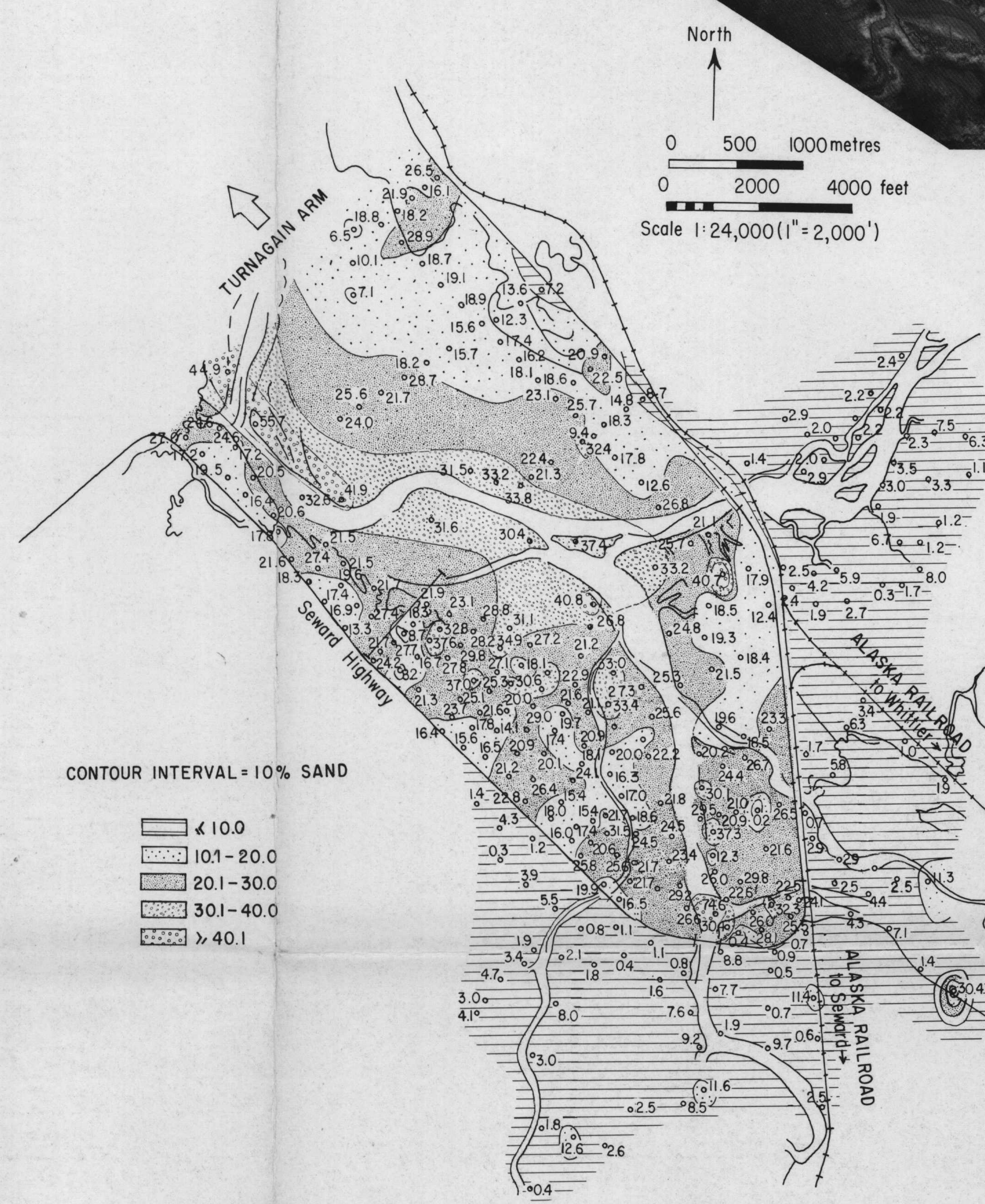

Figure 5. Percent sand of surface samples from Portage Flats (after Bartsch-Winkler and others, in press).

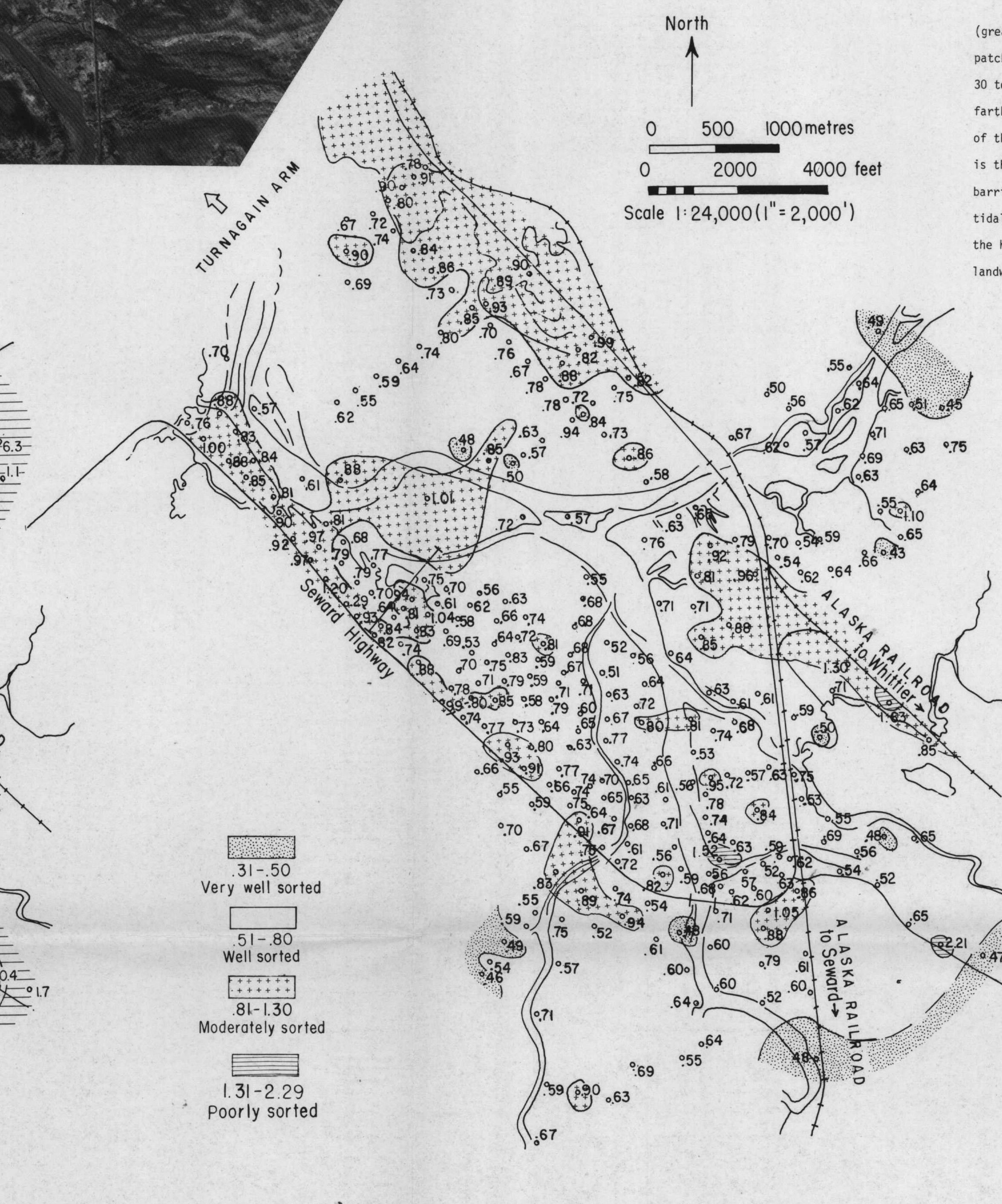

Figure 6. Standard deviations of surface samples from Portage Flats.

Introduction

Tectonic subsidence and sediment consolidation resulting from the 1964 Alaska earthquake (Richter magnitude=8.5) lowered the area surrounding Portage into the intertidal zone of Turnagain Arm. Ground subsidence amounted to as much as 2.4 m, and subsequent deposition spread an estimated $20x10^6$ m^3 of silt over 18 km^2 of land previously above tidewater (Ovenshine and others, 1976). Tidal waters, rather than the three major streams with mouths at Portage, have deposited most of the sediment in the past ten years. Minerals in the sediment must originate in plutonic and volcanic terranes west and north of Turnagain Arm and from coal beds of the Cook Inlet Basin (Ovenshine and Bartsch-Winkler, in press). Between 1964 and 1974, deposition of sediment had almost reached the sediment-tidewater interface, and the area had nearly reached equilibrium (Ovenshine and Kachadoorian, 1976).

Data presented here on the texture of the sediments were measured from samples collected during the summer of 1974 and the spring of 1975.

Portage Flats is an informal name for the intertidal area surrounding the abandoned village of Portage located at the head of Turnagain Arm (fig. 1). Due to compaction of unconsolidated silt and tectonic subsidence of the land at the time of the earthquake, Portage was lowered into the intertidal zone of Turnagain Arm (fig. 2). Therefore, a unique aspect of the flats is that all the sediment presently in the vicinity, to a maximum thickness of 2.5 m, has been deposited since the 1964 Alaska earthquake (Ovenshine and others, 1976).

Aerial photographs

Vertical aerial photographs of the Portage area (fig. 3) were taken on May 25, 1974, near the time of low tide (-0.73m, -2.4 ft mean lower low water at Anchorage, the nearest tidal station). The photographs, at a scale of 1:24,000, were utilized in mapping and sampling the area seaward of the Seward highway embankment during March, 1975.

Sampling and laboratory procedures

Samples were collected mainly during pace-and-compass traverses. Some areas were inaccessible by foot because we were unable to cross filled tidal channels with unstable bottoms and banks, so these areas were sampled using a helicopter. In most places, 80 cm^3 grab samples of surface sediment were collected; in the marshes, sediment collection was more difficult, and in some marsh stations the samples were smaller. The samples were sealed to minimize drying and sent to Menlo Park, California, for textural analysis.

Steps in the textural analysis were: (1) drying at 60° C, (2) weighing, (3) wet-sieving to remove the fraction less than 44 microns, (4) drying, (5) weighing to determine the percent finer than 44 microns, (6) dry-sieving at half-phi intervals, and (7) weighing sieve fractions to an accuracy of 1 mg. Fine fractions were analyzed using a hydrophotometer and methods described by Jordan, Fryer, and Hemmen (1971). A computer program was used to calculate the statistical parameters presented in this report.

Proportion of sand

The sediments of Portage Flats have the highest proportion of sand (greater than 40 percent) nearest the tidal channels (fig. 5). A few isolated patches on the channel edges, in fact, contain gravel. Channel "levees" are 30 to 40 percent sand, and sediments containing 10 to 20 percent sand are found farthest from the channels and topographically highest on the tidal flat seaward of the highway embankment. The most striking feature of the textural map (fig. 5) is the general restriction of the coarser sediment to the seaward side of the highway barrier. Tidal currents landward of the barrier are drastically inhibited, because tidal waters have access to this area only through the five bridge culverts where the highway and railroad cross the main estuaries. With few exceptions, the samples landward of the highway embankment contain over 90 percent silt, and some contain as much as 99 percent silt. Clay is a rare constituent even in these fine sediments, the largest proportion of clay in any sample being 8 percent.

Sorting

Sediment in the Portage area is typically well sorted but ranges from very well sorted to poorly sorted (fig. 6). The water is shallower and tidal currents are of shorter duration at the head of Turnagain Arm at Portage Flats than at the mouth of Turnagain Arm near Cook Inlet. It is not surprising, therefore, that sediment at Portage Flats is less well sorted than sediment sampled elsewhere in Turnagain Arm (Bartsch-Winkler and others, 1975; Bartsch-Winkler and Ovenshine, 1975; Ovenshine, Bartsch-Winkler, and others, 1976), because sorting is related to the volocity and duration of tidal current. At Portage Flats the moderately sorted material is typically found higher on the tidal flat than better sorted material. However, the highway embankment, which so severely restricts tidal flow and sand movement, apparently has little additional effect on sorting of sediment.

Bedforms

Surface ripple marks are not typical features on most of Portage Flats; however, they do occur on the areas closest to the channles and record ebb current flow generally to the northwest. X-radiography reveals the typical bedding features at Portage to be planar bedding (fig. 7), with some areas of small-scale cross-lamination and some disruption by grass rootlets. Notably absent are shells or burrowing structures left by intertidal creatures, which are typical of many high tidal flat areas (for example, Evans, 1964; Klein, 1963; van Straaten, 1954). Cavernous sand (Emery, 1945), formed by entrapment and burial of air as tidewater encroaches over dried sediment surfaces, is typical of the higher grass-covered tidal flats.

An important aspect of the Portage Flats sedimentary environment is its apparent quiescence in winter and early spring. During these seasons snow and ice cover protects the flats, and tidal action apparently is restricted to the tidal channels (fig. 8).

References cited

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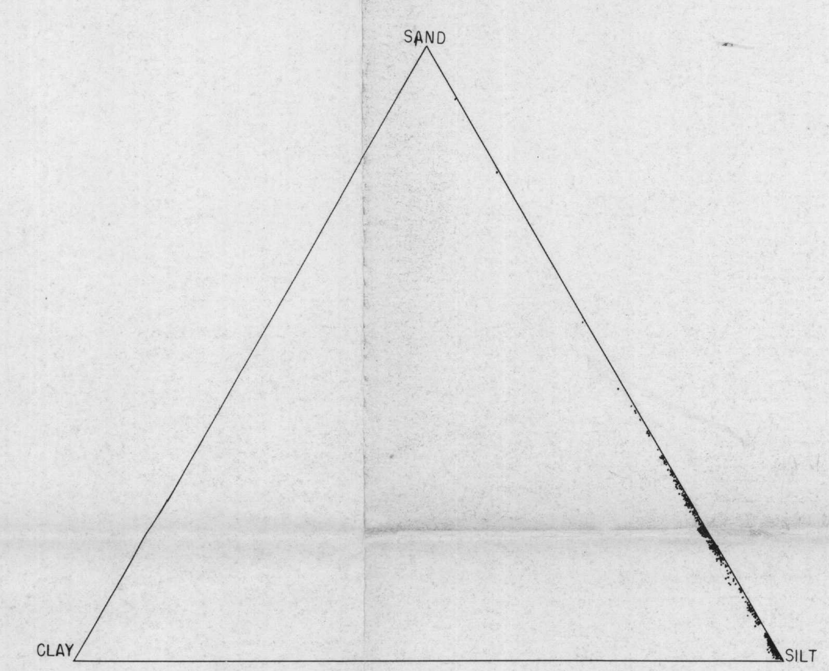

Figure 4. Ternary plot of 280 analyzed surface sediments from Portage Flats.

SEDIMENTOLOGICAL REPORT ON THE SILT OF PORTAGE FLATS, ALASKA, JUNE 1974 THROUGH MARCH 1975

Susan Bartsch-Winkler, A. T. Ovenshine, and Jeff Rupert