UNITED STATES
DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

CONTINUOUS ACOUSTIC PROFILES AND SEDIMENTOLOGIC DATA FROM R/V SEA SOUNDER CRUISE (S-1-76), EASTERN GULF OF ALASKA

Paul R. Carlson, Bruce F. Molnia and William P. Levy

OPEN FILE REPORT 80-65

Menlo Park, California

INTRODUCTION

In June 1976, a scientific party from the U.S. Geological Survey, conducted a high resolution geophysical and seafloor sediment sampling cruise (S-1-76) in the eastern Gulf of Alaska between Sitka and Seward (fig. 1), to obtain data on seafloor hazards pertinent to OCS oil and gas lease sale activity. We had previously participated in four cruises to this area and had begun developing a regional "picture" of the geologic hazards on the continental shelf, between Prince William Sound and Yakutat Bay. Cruise S-1-76 was planned to investigate, in greater detail, specific hazards previously identified on this portion of the shelf and to run some reconnaissance lines on the shelf east of Yakutat Bay. In addition to the data collected on the shelf, we used this opportunity to investigate the three major navigable bays that interupt the coast line in this portion of the eastern Gulf of Alaska (Lituya Bay, Yakutat Bay, and Icy Bay-fig. 1).

This report contains a list of the seismic reflection records and shipboard logs that are publicly available and includes trackline maps and a text. Included in the report are: (1) examples of characteristic seismic profiles, (2) descriptions of geologic hazards observed on specific profiles, and (3) summary descriptions of sediment samples and bottom photographs. Microfilm or paper prints of the seismic reflection records and shipboard logs are available for viewing:

(1) U.S. Geological Survey
Pacific-Arctic Branch of Marine Geology, Room B171
345 Middlefield Road
Menlo Park, CA 94025
Phone 415-323-8111, ext. 7132

or for purchase:

(2) National Geophysical and Solar Terrestrial Data Center
EDS/NOAA
Boulder, Colorado 80302

Acknowledgements

The cruise was supported jointly by the U.S. Geological Survey and by the Bureau of Land Management through interagency agreement with the National Oceanic and Atmospheric Administration, under which a multi-year environmental hazards study of the Alaskan continental shelf is managed by the OCSEAP office.

We appreciate the assistance provided by the scientific personnel on the cruise (Andrew Alden, Darlene Condra, John Cudnohufsky, Paul Fuller, Rich Garlow, Jack Hampson, Harry Hill, Dennis Kerr, Steve Kittelson, Austin Post, Paula Quinterno, George Redden, Glen Schumacher, Steve Wallace and Elias Zendejas); the ship's Captain (Alan McClenaghan) and crew; and the shore-based navigation group (Richard Tagg and William Clique).

METHODS

SEA SOUNDER cruise S-1-76 left Sitka June 5, 1976, for work in OCS lease sale area 39 (Eastern Gulf of Alaska) and arrived at Seward June 16, 1976. Maps 1, 2, and 3 show the tracklines of the cruise, except transit line 600 shown on figure 4 and details of the Lituya Bay lines on figure 11; both samples and tracklines are numbered sequentially. Navigation positions were determined by satellite, Loran A, miniranger, radar and dead reckoning. Not all systems were used simultaneously: Table 1 shows the type of navigation systems that were used for the various segments of the cruise.

Seismic reflection records were made using the following equipment: 90 kiloJoule sparker (857 km of trackline), 800 Joule boomer (1512 km) and 3.5 kiloHertz transducer (2300 km) along the tracklines shown on maps 1-3. Records were also collected with a side-scan sonar (200 km) and a magnetometer (800 km) along selected tracklines. Sediment samples (86 total) were collected with a large gravity corer (9 cm I.D. x 3 to 6 m length barrels) and with grab samplers (Van Veen and Shipek). The location of these sample stations are shown on the trackline maps 1-3. A 35 mm bottom camera was deployed at three stations and an underwater television camera at eleven stations.

Examples of the annotated seismic records are shown in figure 2, and examples of the shipboard logs for the seismic systems are included in figure 3. The sequence of events on the cruise is summarized in table 1, the descriptions and locations of the sediment samples are listed in table 2, and summaries of the results of television and bottom camera stations are compiled in tables 3 and 4.

DISCUSSION OF DATA

Brief discussions of major features observed with seismic profiling, sediment sampling, television, or seabed photographic viewing techniques follow for the various geographic areas. For ease in description, the study region has been divided into 14 areas (fig. 1). The areas will be discussed in the approximate order sampled: (1) Sitka to Cross Sound, (2) Cross Sound to Lituya Bay, (3) Lituya Bay, (4) Fairweather Ground, (5) Alsek and Yakutat Sea Valleys, (6) Yakutat Bay, (7) Malaspina Glacier nearshore area, (8) Icy Bay, (9) Bering Trough, (10) Kayak Island East, (11) Kayak Trough, (12) Copper River Prodelta, (13) Tarr Bank, and (14) Hinchinbrook Sea Valley.

(1) Sitka to Cross Sound (Line 600 - sample 600). Line 600 is a transit line from Sitka to Cross Sound along which only the 3.5 kHz system was operated. Figure 4 is a sketch map showing the location of this trackline. The first third of this line (600) traverses a very hard, irregular, seafloor between Baranof, Kruzof and smaller islands that consist primarily of Triassic-Jurassic metasedimentary rocks (Loney and others, 1975). In Salisbury Sound, the hard bedrock seafloor persists, but pods of soft sediment up to 20 m thick, are present in the numerous irregular depressions crossed by this trackline along the length of the sound. The hard, knobby bedrock bottom continues to about 0300 hrs (fig. 5) at which point a change in seafloor morphology occurs. A much flatter seafloor persists to the end of trackline

600. A grab sample consisting of gravelly, sandy mud was collected at the end of line 600. The pebbles and cobbles (up to 10 cm in diameter) were rounded to sub-rounded, granitic and metasedimentary rock types with encrusting organisms.

(2) Cross Sound to Lituya Bay (lines 601-615; samples 601-612). Seismic profiles were obtained in this area for a three-fold purpose: (1) to check for evidence of glacial moraines within or adjacent to Cross Sound; (2) to investigate the seaward extension of the Fairweather fault between Palma Bay and Cross Sound; and (3) to see if the seismic profiles would show any glacial channeling on this portion of the shelf.

a. Cross Sound, the northernmost outlet of the famed "inland passage," is 15 km wide, 20 km long and contains the landward part of a large sea valley that extends to the edge of the continental shelf. The seafloor underlying Cross Sound is very rugged containing numerous bedrock knobs and crags, morphology that is consistent with the rugged coastline of the adjacent land masses mapped as Mesozoic metasedimentary and metamorphic rocks (Plafker, 1967a, Loney and others, 1975; and Brew and others, 1978).

The only recognized moraine along the Cross Sound line (601) was profiled in Taylor Bay where a prominent ridge (fig. 6) extends across the mouth of the bay. This ridge, that has relief of 40-70 m (fig. 7) is one of the end moraines deposited by the Brady Glacier. Morainal material cropping out along the shoreline of Taylor Bay (Derksen, 1976), is located along the trend of the submarine ridge shown on our profiles (fig. 6). Derksen (1976) has assigned an early Neoglacial age (∿ 1230-1960 yrs. B.P.) to the onshore remnants of this moraine. Both crossings of the moraine show some discontinuous reflectors in the 15-20 m thick sequence of sediment located seaward of the moraine.

Outwash material from the Brady Glacier is being ponded behind the end moraine. The thickness of this outwash sediment is as great as 50 m. The seismic records show distinct, continuous, parallel bedding of the modern sediment that suggests deposition of glacial flour perhaps interspersed with layers of coarser clastics transported by slump-triggered density or turbidity currents. If we assume that this sediment has been accumulating for the past 1230 years, then the 50 m thick layer of sediment has been accumulating at a rate of about 4 cm/yr. In the inner part of Taylor Bay, the rate of sediment accumulation is about an order of magnitude greater (Molnia, 1979). The seismic line that traverses the west side of Taylor Bay (fig. 8) shows what seem to be large bed forms with some internal reflectors. The largest of these features has a height of 10 m and a wave length of 0.2 km (fig. 8). Until additional profiles and some sediment samples are obtained, the makeup and orientation of these features will remain unknown.

b. Palma Bay, a re-entrant in the shoreline 30 km north of Cross Sound, marks the southeastern end of the Fairweather Fault as mapped on land by Plafker (1967a). This fault is believed to be a transform boundary between the North American and Pacific crustal plates along which average displacement has occurred at a rate of approximately 5 cm/yr (Plafker and others, 1978). Lines 601-607 were planned to cross the seaward extension of the

Fairweather Fault. Evidence for mapping the trace of this major fault on the shelf, at least as far south as Cross Sound, was observed on lines 601, 603, 605, and 607 (fig. 6). On these four crossings, the largest surficial offset of this major strike-slip fault (∿ 25 m) was observed on line 605 (fig. 9). Additional seismic reflection profiles obtained in the summer of 1978 (cruise S-5-78), have shown the southeastern continuation of the Fairweather Fault across the continental shelf and upper slope to at least Chatham Strait (Carlson and others, in press).

c. Between Palma Bay and Lituya Bay, a distance of 40 km several large glaciers either reach or approach the shoreline. La Perouse Glacier extends to the shoreline and the termini of South Crillon, west lobe of La Perouse, and Finger Glacier are within a few kilometers of the shoreline. During the lowstands of sea level in Pleistocene time some and perhaps all of these glaciers flowed across the continental shelf. Lines 608-615 were planned to cross in front of these glaciers to see if glacial troughs or channels could be detected that may have been cut into the shelf sediments during low stands of sea level. A previous seismic cruise using a 300J minisparker as a power source, had crossed some buried channels near the entrance to Lituya Bay (Molnia and others, 1978c), but lines 608-615 were run with only a 3.5 kHz profiler and do not show sufficient penetration to indicate the presence of buried channels. Some of the records show a relatively thin (10-40m) surface veneer of transparent sediment (Holocene) over an irregular erosion surface (fig. 10). The erosion surface probably was cut during the last low stand of sea level.

(3) Lituya Bay (lines LBA - LBP; samples 613 - 615). Lituya Bay on the northeast shore of the Gulf of Alaska, is a T-shaped tidal inlet, 11 km long and 3 km wide at the upper end of the "T". Fifty km of 3.5 kHz Bathymetry and Uniboom high resolution seismic data were obtained within the bay (fig. 11) in order to check for evidence of landslide debris on the floor of the bay.

The upper part of the "T", with Gilbert Inlet and Lituya Glacier to the north and Crillon Inlet and North Crillon Glacier to the south, is located on the trace of the active Fairweather Fault. Several rockslides associated with movement along the fault, have caused at least four known great waves in the bay (Miller, 1959). The most recent of these occurred on July 9, 1958, when ground shaking triggered by a magnitude 7.9 earthquake caused about 31 million cubic meters of rock to slide into Lituya Bay (Miller, 1959). From its location in Gilbert Inlet (fig. 11), the slide generated a giant wave whose maximum surge was over 530 meters high. High resolution seismic data show what is probably the buried debris of this massive rock-slide. Hummocky, very irregular reflectors typify the fjord floor in front of the slide (fig. 12). These features seem to be the only apparent rockslide related morphology visable.

Several smaller filled channels (< 1 km wide) and larger U-shaped valleys (∿ 2-3 km wide) are also seen on the records (fig. 13). As much as 120 meters of sediment has accumulated in some channels. Resurveying by the Coast and Geodetic Survey, after the major earthquake in 1958, revealed major shoaling in these channels and U-shaped valleys with some channels reduced 79 meters in axial depth (Jordan, 1962), suggesting that debris from the rockslides has been a major source of the sediment accumulating in Lituya Bay. Bedrock is seen both cropping out and buried under a thin sediment veneer. The rocks on land adjacent to this area have been mapped as crystalline complex, metasediments, and a moderately metamorphosed volcanic group, all Mesozoic in age (Plafker, 1967a). Generally bedrock close to the surface is confined to the steep sides of the bay or forms the Cenotaph Island platform.

(4) Lituya Bay to Fairweather Ground to Alsek Sea Valley (lines 616-619, samples 615-626). Line 616 is a transit line which begins in Lituya Bay and extends across the continental shelf to Fairweather Ground, a structural and topographic high close to the shelf edge. The nearshore end of the line shows a layered Holocene section of varying thickness overlying glacially sculptured bedrock. The Holocene section reaches a maximum thickness of about 100 m. Record quality is noisy and the glacially modified bedrock is lost about 0100 hrs. This bedrock reflector reappears occasionally thereafter. Beginning at 0245 hrs., the seafloor becomes more irregular than nearer to shore and is underlain by a series of dipping and eroded reflectors. Small channels are present in the subsurface reflectors. These channels persist to at least 0400 hrs. when record quality again deteriorates.

Beginning at 0555 hrs., steeply dipping sub-surface reflectors, characteristic of Fairweather Ground (Molnia, and others 1978c) first appear. The Fairweather Ground area is characterized by rocky outcrops with pockets and ponds of sediment. Relief is variable with the shallowest depth being less than 40 m.

Lines 617, 618, and FA-1 all show the irregular Fairweather Ground morphology seen on the end of line 616. Samples 615-625c were collected on these three lines. The samples include mud and small rock fragments.

Line 619 is a transit line from Fairweather Ground to the edge of the continental shelf and then down the continental slope. An unusually narrow pinnacle of basement crops out about 2145-2148 hrs. The shelf break appears at 2218 hrs at a depth of about 255 m. Evidence of slumping and possibly faulting exist at and near the shelf break.

(5) Alsek and Yakutat Sea Valleys (lines 620-625; samples 627-634). These two sea valleys are prominent incisions in the continental shelf. Seismic lines were run along the axis of Alsek and the upper part of Yakutat Sea Valleys to determine thickness and geometry of sediment fill, to study the seismic stratigraphy of these cross-shelf conduits for water and sediment, and to observe the types of structural features underlying these sea valleys.

Alsek Sea Valley begins about 5 km seaward of Dry Bay in 80 m of water. This exceedingly straight, 20 km wide, U-shaped valley extends 90 km to the shelf edge at a depth of 215 m. The deepest parts of the sea valley reach 250 m below sealevel near a middle shelf location.

The 90KJ sparker profile obtained along the lower half of line 620 shows a well-defined angular unconformity covered by 100-150 m of Holocene sediment (fig. 14). Below the unconformity, the reflectors dip gently landward on the inner two-thirds of the shelf. On the outer one-third of the shelf, the dip becomes steeper and the structures more complex. At the outer edge of the shelf (0040 hrs, line 620), the Holocene sediment wedges out and the underlying more lithified strata crop out. At the shelf break, these strata are faulted and form a prominent bedrock knob or ridge, which is probably a continuation of the shelf edge structural high at Fairweather Ground located east of the sea valley.

At the shoreward end of Alsek Sea Valley (1020-1110 hrs., line 620), surface irregularities and discontinuous reflectors suggest sliding within the upper 10-20 m of Holocene sediment. Surficial features attributed to gas-charged sediment were seen on other high-resolution seismic records in this nearshore area off the Alsek River (Molnia and others, 1978a, and 1978c). Additional sampling is needed to determine the quantity of excess gas present in these sediments. If the sediments are "gas-charged," the influence of this gas upon the pore pressures of the sediment would create instability that could be triggered into sliding by the earthquakes and frequent storm waves that impinge on this exposed coast.

Lines 622-624 were run parallel to shore between Alsek and Yakutat Sea Valleys to see if any channels were evident in this nearshore zone. A clearly defined buried channel one km wide and filled with 20 m of fill was crossed on line 622 ($\sim$ 2200 hrs) west of Dry Bay (fig. 15). Additionally channel and cut and fill features were evident on lines 623 (2330-0040 hrs) and 624 (0430-0720 hrs). A more detailed grid of high resolution seismic lines is needed to determine the lateral extent of these channels. The buried channels and a well-defined erosion surface are covered by 20-25 m of Holocene sediment. The source of most of the sediment was probably the 385 km long Alsek River that carries large quantities of sediment to the Gulf of Alaska (Molnia and others, 1978b) where the dominantly counterclockwise nearshore currents move the sediment to the west (Reimnitz and Carlson, 1975).

Yakutat Sea Valley is an anomally among the sea valleys that cross the continental shelf in the eastern Gulf of Alaska. The unusual shape of the valley appears to result from structural control (Carlson and others, 1977a; Schwab, Bruns and von Huene, in press). The upper end of Yakutat Sea Valley parallels the coastline seaward of Yakutat for $\sim$ 90 km and then the valley makes a broad turn extending to the shelf break, a distance of $\sim$ 70 km. The 90 KJ sparker record run along the thalweg of the upper end of the sea valley shows 50-100 m of Holocene sediment overlying well-defined gently undulating reflectors at 100-150 m and 200-250 m deep in the section. In a few places, some channel-like features are outlined by occasional reflectors below the lowermost continuous reflector. A filled channel is present where the sea valley makes the broad bend (fig. 16). This channel is about 10 km in width and has a relief of nearly 100 m. Additional crossings are needed to determine if this buried channel coincides completely with the present Yakutat Sea Valley or if it represents a branch of an ancient sea valley.

(6) Yakutat Bay (lines 635-643). This glacial fjord, that was last filled by the Hubbard Glacier between 700 and 1000 yrs ago (Plafker and Miller, 1958), contains the only community with harbor facilities along a 600 km stretch of coast in the eastern Gulf of Alaska between Prince William Sound and Cross Sound. Because of the possibility of discovering petroleum on the nearby continental shelf and the resulting impact of such activity on Yakutat Bay, reconnaissance seismic lines (635-643) were run to begin a preliminary geohazards survey of the bay. In addition to searching for submarine slumps and evidence for active faults, we wanted to determine the location of end moraines and the seismic characteristics of modern sediments ponded in the basins between moraines.

There are three discrete but very irregular morainal ridges in Yakutat Bay (Carlson and others, 1978). Lines 636, 637, and 638 cross portions of the outer bay moraine (fig. 17). Line 636 crosses a part of the basin formed by the outer moraine. This part of the basin has been filled with up to 70 m of sediment, some of which seems to have slumped off the basin's west wall (fig. 18). In addition to the sediment introduced by slumps and sediment flows, a large amount of glacial flour has settled out from the plumes of turbid water that develop from the discharge of the numerous melt water streams that drain the large glaciers of southeastern Alaska (Reimnitz and Carlson, 1975; Molnia and others, 1978b). If we assume deposition began in the basin 750 years ago, the average rate of sediment accumulation could be as high as 9 cm/yr. Based on additional seismic data, Carlson and others (1978) reported rates to 25 cm/yr in the basin behind the bay mouth moraine and 70 cm/yr in the basin behind the upper bay moraine (fig. 17). The maximum thickness of modern sediment in Yakutat Bay, measured on the S-1-76 records, range from 60 to 105 m. Figure 17 shows where these thicknesses occur and how they compare with thicknesses and accumulation rates obtained from a later cruise.

(7) Malaspina Glacier nearshore (lines 626-634 and 644-656; samples 635-645). Seismic and side scan sonar profiles and sediment samples were obtained on the shelf seaward of this large piedmont glacier in order to determine if an area interpreted as a submarine slump (Carlson and others, 1975; Carlson and Molnia, 1977a): had been correctly identified and if the slump is presently active. The seismic profiles and side scan sonographs from S-1-76 and seismic data from four previous cruises were used by Carlson (1978) to reinforce the original interpretation and to more accurately delineate the area affected by slumping. The type of movement was progressive slumping along an incompetent zone of Holocene sediments 15-40 m thick. The existence of small incipient scarps detected on the side scan sonographs (fig. 19) showed active headward growth of the slump. The most likely triggering forces for continued slumping on the rapidly accumulating, underconsolidated sediments are earthquakes and/or storm waves (Carlson, 1978). Additional data such as in situ soil strength and pore water pressure measurements, however, are needed to more fully understand the mechanics of mass movement of this glacially derived sediment.

(8) Icy Bay to southeast of Bering Trough (lines 657-659, samples 646-655). Lines 657 and 658 are two short lines of variable course in Icy Bay, an enlarging bay first formed in 1904 by the retreat of Guyot Glacier (Molnia, 1977, 1979). The profiles show a series of sediment filled basins separated by moraines and bedrock ridges. The northern end of 658 is in Tyndal Fiord where the morainal ridge is shallower than 20 m (658, 2300-000 hrs). Line 658 continues offshore of Icy Bay and shows a series of well bedded Holocene reflectors. Between 0410 and 0445 hrs, the Malaspina Slump (Carlson, 1978) is traversed. Line 659 crosses the flat lying sediment of the outermost continental shelf and descends the continental slope. The shelf break occurs at 0619 in a water depth of about 220 m.

(9) Bering Trough (lines 660-670, samples 656-658) Line 660 is a northwest trending line that runs parallel to the axis of Bering Trough. The line begins on the continental slope, but data quality is very poor with only occasional traces of the bottom until about 1120 hrs. A Uniboom profile that begins at 1310 hrs shows a thick section of well stratified Holocene layers that dip seaward. Several sections of line 660 show evidence of slumping including 1420-1430 and 1510-16 hrs.

Lines 661-670 were run to investigate the distribution of slumps and to investigate the possibility that part of upper Bering Trough may be underlain by buried relict ice (Molnia, 1976). Examples of the slump-related seafloor irregularities (fig. 20) in upper Bering Trough can be seen on profiles 662 (1653-1718), 662 B (1742-1812), 663 (1918- at least 2040), 664 (2255-2358), 668 (all), and 669 (start - 0703). High winds and rough seas resulted in poor quality records on lines 663-666.

(10). Kayak Island East (lines 672-674; samples 658-659). Although high resolution seismic records were obtained east of Kayak Island, all records in this area are of poor quality with distorted surficial returns as well as almost no subsurface penetration, due to heavy sea state conditions. Seismic profiles from other USGS cruises in the area, show a relatively smooth seafloor in this area except for several anomalous sub-bottom reflectors that have been postulated to be indicators of gas-charged sediments (Kvenvolden and others, 1977. Samples collected at station 659 showed methane contents as high as 20 nl/gm. Subsequent cruises have verified the anaomalous gas contents (Molnia and others, 1978a).

(11) Kayak Trough (line 675; samples 660-662; TV stations 1-3). This glacially scoured trough was investigated because previous seismic data showed that a large submarine slide ($5.9 \times 10^9 m^3$) had flowed down the north wall of the trough onto the trough floor to water depths greater than 200 m (Carlson and Molnia, 1975 and 1977; Molnia and others, 1977). Although this slide had previously been described, we wished to determine more about the head wall scarp and variations in morphology of various parts of the slide, especially numerous secondary scarps seen on the slide surface. High-resolution seismic reflection records obtained in Kayak Trough were of low quality because of the sea state and hydrophone problems, but some useful side-scan sonar and television coverage was obtained of portions of the Kayak slide area. Television station 1 located north of the head wall scarp, showed distinct symmetrical ripples and burrowing. Television stations 2 and 3 are both located south of the scarp. Station 2 in 118-125 meters of water also showed extensive burrowing and less developed ripples. An adjacent terrain was characterized by large burrow holes (2-3 cm), depressions and mounds. Features associated with the slide, seen on the television at this station included steep scarp faces (50 cm high) with broken bedding planes and large blocks of sediment.

Station 3 located in 50-62 meters of water also showed several steep scarps as well as several irregular scarplets. Again the seafloor was extensively burrowed as in station 1 and distinct symmetrical ripples were observed though many were disrupted by burrowing. All three television stations had sediments consisting of clayey silts.

(12) Copper River Prodelta (lines 676 - 679; samples 663 - 666; TV stations 4 and 5). The Copper River is one of the principal sediment suppliers to the Gulf of Alaska. This area of rapid sediment accumulation (10-15 m/1000 yrs; Carlson and others, 1977b)was revisited because previously obtained seismic reflection data showed a large area of progressive slumping on the prodelta (Carlson and others, 1975). Subsequent seismic and sedimentologic data from this area of slumping indicated that high rates of sedimentation resulting in underconsolidation and excess pore pressure were causative factors in the slope instability (Carlson and Molnia, 1977; Hampton and others, 1978). There were

also indications of gas-charged sediments in close association with the slump mass (Kvenvolden and others, 1977). Numerous bedforms were observed at television station 4 on line 676 in 20 meters of water on the prodelta (table 3). Complex asymmetric ripple sets showing possibly two trending directions had formed in a fine sand substrate whereas more unidirectional ripple sets were found in adjacent areas. The ripple sets appeared recent as their crests were very distinct. No burrows and few benthic fauna were observed. Television station 5, in Egg Island Trough located at the western edge of the prodelta in 90-100 meters of water, showed a bottom that was markedly different than the previous station. Here the seafloor consisted of clayey silt with extensive burrowing and distinct bioturbation. No bedforms were seen at this station.

(13) Tarr Bank (Lines 680-684; samples 667-669; TV stations 6-8). Tarr Bank is a mid-shelf topographic high located between Hinchinbrook and Middleton Islands. Seismic profiles collected on previous cruises showed an uplifted bedrock bank that appeared to be devoid of Holocene sediment. On this cruise we wanted to determine the types of surficial sediment present on Tarr Bank. These data were used for distinguishing boundaries of sediment types as mapped by Carlson and others, (1977b). Seismic reflection line 680 which extends from the Copper River prodelta to Tarr Bank, has very little subsurface penetration and shows no significant morphology on the seismic reflection profiles. Television station 6 is at the end of this line off the eastern edge of Tarr Bank. Surface sediments at this station were soft muds with some benthic organisms, many burrows and branching trails visible on the television images. The surface is undulating with many large depressions (possibly caused by organisms) and some faint rippling observed.

Line 681, across Tarr Bank, showed hard rock near the surface covered by a thin layer of soft sediment, whereas lines 682 and 683 show almost no penetration. At the end of line 683, another television station was occupied. This station had the clearest video of all the Tarr Bank stations. In this area, 2 km northwest of Wessel's Reef, there was relatively little fine sediment on the seafloor. Many large boulders of probable glacial origin, sand surfaces with cobble cover, several areas of shell hash and a large population of benthic and encrusting organisms were observed throughout the area. Higher wave energy in this shallower region (60 m water depth) seems to explain the lack of mud on this bank located within 50 km of the Copper River, the principle sediment source in the northern Gulf of Alaska.

Television station 8 is very similar to station 7 as here again a sandy bottom is seen with cobble to boulder cover. Although there are many benthic organisms, there is no shell hash or mollusk shell cover in this slightly deeper area (70 m).

(14) Hinchinbrook Sea Valley (lines 685-687; TV stations 9-11). Seismic reflection profiles were collected in this area to investigate the morphology of the sea valley, to determine the thickness of Holocene sediment overlying the bedrock into which the valley was cut, and to obtain additional data over the seaward extension of the Patton Bay Fault to the southwest of Montague Island. Television stations were occupied in order to observe the type of sediment that is filling the sea valley and the types of benthic organisms present in this environment.

As line 685 approaches Hinchinbrook Sea Valley, a bedrock ridge is encountered with a scoured channel on either side. This is possibly an extension of the nearby Seal Rocks that are located to the southwest of line 685. These islands consist of subquartzose sandstones of the Eocene age Orca Group (G. Winkler, 1976, oral communication). Profiles along line 686 have a rugged terrain of steep ridges and troughs and also show channels around the margin of the ridge indicating that this channel is a fairly extensive feature.

Line 687 crosses Hinchinbrook Sea Valley, a long, relatively shallow, glacially carved sea valley (Carlson and others, 1977a). Television stations 9 and 10 were deployed in and on the flank of the sea valley respectively. Both stations are in soft muddy sediment. Suspended sediment possibly originating from the Copper River, is present in the water column. Many benthic organisms are seen at these sites with many associated burrows and tracks. Another television station along the sea valley (station 11) has abundant suspended sediment in the water column and a discontinuous cobble cover over soft muddy sediment that contains numerous burrows and tracks.

Surface faults seen on profile 687 (fig. 21) fall along the postulated submarine extension of the Patton Bay fault on Montague Island. The breaks in the surface observed on seismic reflection profiles lie within a tectonically active zone of crustal shortening and uplift associated with the 1964 earthquake (Plafker, 1967b). Other possible fault traces are seen along this line that may correlate with faults on land, but additional surveys are needed to determine the extent of these fault scarps.

Some possible morainal material is seen on line 687 near Resurrection Bay in the form of many hard parabolic reflectors and irregular surface features that appear at this Bay's entrance.

References Cited

Brew, D. A., Johnson, B. R., Grybeck, Donald, Griscom, Andrew, Barnes, D. F., Kimball, A. L., Still, J. C., and Ratajl, J. L., 1978, Mineral resources of the Glacier Bay National Monument Wilderness Study Area, Alaska: U.S. Geological Survey Open File Report 78-494, 665 p., 6 maps.

Carlson, P. R., 1978, Holocene slump on Continental shelf off Malaspina Glacier, Gulf of Alaska: Am. Assoc. Petroleum Geol. Bull., v. 62, p. 2412-2426.

Carlson, P. R., Bruns, T. R., and Molnia, B. F., 1975, Submarine slides and nearsurface faults, northern Gulf of Alaska: U.S. Geol. Survey Open-file Report No. 75-504, 6 p.

Carlson, P. R., Bruns, T. R., Molnia, B. F., and Hampson, Jr., J. C., 1977a, Submarine valleys on the continental shelf, northeastern Gulf of Alaska: Geol. Soc. America Abstracts with Programs, v. 9, no. 7, p. 921.

Carlson, P. R., and Molnia, B. F., 1975, Massive submarine slide in the Gulf of Alaska: Geol. Soc. America Abstracts with Programs, v. 7, no. 7, p. 1018.

Carlson, P. R. and Molnia, B. F., 1977, Submarine faults and slides on the continental shelf, northern Gulf of Alaska: Marine Geotechnology, v. 2, no. 1, p. 275-290.

Carlson, P. R., Molnia, B. F., Kittelson, S. C. and Hampson, J. C., Jr., 1977b, Distribution of bottom sediments on the continental shelf, northern Gulf of Alaska: U.S. Geol. Survey Miscellaneous field studies maps and text, MF 876. 2 map sheets and 13 p. pamphlet.

Carlson, P. R., Molnia, B. F., Hampson, J. C., Jr., Post, Austin, and Atwood, T. J., 1978, Post-deglaciation sedimentation in Yakutat Bay, Alaska: Transactions, Am. Geophysical Union, EOS, v. 59, p. 296.

Carlson, Paul R., Plafker, George, Bruns, Terry R., and Levy, William P., in press, Seaward extension of the Fairweather fault: U.S. Geological Survey Circular.

Derksen, S. J., 1976, Glacial geology of the Brady Glacier region, Alaska: Inst. Polar Studies Rept. 60, The Ohio State Univ., Columbus, Ohio, 97 p.

Hampton, M. A., Bouma, A. H., Carlson, P. R., Molnia, B. F., Clukey, E. C., and Sangrey, D. A., 1978, Quantitative study of slope instability in the Gulf of Alaska: 10th Offshore Technology Conference, Houston, Tex., Proceedings, v. 4, p. 2307-2318.

Jordan, G. F., 1962, Redistribution of sediments in Alaskan bays and inlets: Geographic Review, v. 52, p. 548-558.

Kvenvolden, K. A., Redden, G. D., and Carlson, P. R., 1977, Hydrocarbon gases in sediments of the eastern Gulf of Alaska: Am. Assoc. Petroleum Geologists Bull., v. 61, p. 806.

Loney, Robert A., Brew, David A., Muffler, L. J. Patrick, and Pomeroy, John S., 1975, Reconnaissance Geology of Chichagof, Baranof, and Kruzof Islands, Southeastern Alaska; U.S. Geological Survey Professional Paper 792, 105 p.

Miller, Don J., 1959, The Alaska Earthquake of July 10, 1958: Giant Wave in Lituya Bay; Bulletin of the Seismological Society of America. Vol. 50, No. 2, pp. 253-266. April, 1960.

Molnia, B. F., 1976, Possible submarine ice-cored topography in the Bering Trough, NE Gulf of Alask: Geol. Soc. America Abstracts with Programs, v. 8, p. 1016.

Molnia, B. F., 1977, Rapid shoreline erosion at Icy Bay, Alaska - a staging area for offshore petroleum development: Proceedings of the 1977 Offshore Technology Conference, p. 115-126.

Molnia, B. F., 1979, Sedimentation in coastal embayments, northeastern Gulf of Alaska; Proceedings of the 1979 Offshore Technology Conference, p. 665-670.

Molnia, B. F., Carlson, P. R. and Bruns, T. R., 1977, Large submarine slide in Kayak Trough, Gulf of Alaska; in Landslides, D. Coates, ed., Engineering Geology Reviews, Geol. Soc. Am., v. III, p. 137-148.

Molnia, B. F., Carlson, P. R. and Kvenvolden, K. A., 1978a, Gas-charged sediment areas in the northern Gulf of Alaska: Geol. Soc. America Abstracts with Programs, v. 10, p. 458-459.

Molnia, B. F., Carlson, P. R., and Levy, W. P., 1978b, Holocene sediment volume and modern sediment yield, northeast Gulf of Alaska: Am. Assoc. Petroleum Geologists Bull., v. 62, p. 545.

Molnia, B. F., Carlson, P. R. and Wright, L. H., 1978c, Geophysical data from the 1975 cruise of the NOAA ship SURVEYOR: U.S. Geol. Survey open-file report 78-209.

Plafker, George, 1967a, Geologic Map of the Gulf of Alaska Tertiary Province, Alaska: U.S. Geol. Survey Misc. Geologic Invest. Map I-484.

Plafker, George, 1967b, Surface faults on Montague Island associated with the 1964 Alaska Earthquake: U.S. Geol. Survey Prof. Paper 543 G, 42 p.

Plafker, George, Hudson, Travis, Bruns, Terry, and Rubin, Meyer, 1978, Late Quaternary Offsets Along the Fairweather Fault and Crustal Plate Interactions in Southern Alaska; Canadian Journal of Earth Sciences, Vol. 15, No. 5, 1978, pgs. 805-816.

Plafker, George, and Miller, D. J., 1958, Glacial features and surficial deposits of the Malaspina district, Alaska: Miscellaneous Geologic Investigation Map I-271.

Reimnitz, E., and Carlson, P. R., 1975, Circulation of nearshore surface water in the Gulf of Alaska: in Carlson, P. R., Conomos, T. J., Janda, R. J., and Peterson, D. H., Principal sources and dispersal patterns of suspended particulate matter in nearshore surface waters of the northeast Pacific Ocean: ERTS Final Report, Natl. Tech. Info. Service, E75-10266, 145 p.

Schwab, W., Bruns, T. R., and von Huene, R., in press, Structural interpretation of magnetic lineaments in the Northern Gulf of Alaska: U.S. Geol. Survey Miscellaneous field studies.

Table 1 Cruise Summary - June 1976 (R/V SEA SOUNDER S-1-76)

Date	JD	Time (Z)	Tracklines	Navigation	Comments
June 28	157	1600			LV Sitka
	158	0200	600		SOL Sitka Sound to
	158	0615			EOL Cross Sound
	158	0821	601		SOL Cross Sound
	158	1756	601		EOL
	158	1838	602-		SOL Palma Bay
	159	0246	607		EOL (Fairweather Fault)
		0322	608-		SOL Icy Point to
		1600	615		EOL Lituya Bay Entrance
		1620	LB-A	Sat. Nav.*	SOL Lituya Bay
		2220	LB-P	and	EOL
	159	2328	616	Loran A	SOL Lituya Bay to
July 1	160	0745	616		EOL Fairweather Ground
		0959	FA-1		SOL Fairweather Ground to
		2311	619		EOL Alsek Sea Valley
	160	2330	620		SOL Alsek Sea Valley
	161	1630	AC-1		EOL
		1633	621		SOL Alsek Sea Valley to
		1917	621		EOL Alsek River (Dry Bay)
	161	2001	622		SOL Seaward of Alsek River
	162	1530	625		EOL to Malaspina Glacier
	162	0930	626	Miniranger	SOL Icy Bay-Malaspina slump
	163	0751	635	and Sat. Nav.	EOL
	163	0803	636	Radar and	SOL Yakutat Bay
	164	0045	643	D.R.**	EOL
		0148	644	Miniranger	SOL Icy Bay-Malaspina slump
		1540	655	and Sat. Nav.	EOL
		1545	656		SOL Seaward of Malaspina Glacier
		1748	656	Radar and	EOL Icy Bay
		1800	657	D.R.	SOL Icy Bay to
	165	0514	658	Sat. Nav.	EOL Pamplona Ridge
		0515	659	and Loran A	SOL Pamplona Ridge to slope
		0821	659		EOL S.E. of Bering Trough
		0912	660		SOL Bering Trough
	166	1041	670		EOL
		1042	671	Sat. Nav.	SOL Bering Trough to
		1237	671	and Loran A	EOL Southeast of Kayak Island
		1305	672		SOL Kayak Island
		1809	673		EOL Gas-charged sediment
		1810	674		SOL S.E. Kayak Island to
		1930	674		EOL Kayak Trough
	166	1945	675		SOL Kayak Trough
	167	0610	675		EOL
		0616	676		SOL Copper River Prodelta
		1955	680		EOL
		2134	681	Sat. Nav.	SOL Tarr Bank
	168	0342	684	Radar	EOL
		0508	685	and D.R.	SOL Tarr Bank to
		0715	685		EOL Hinchinbrook Sea Valley
		0802	686		SOL Hinchinbrook Sea Valley
		1105	686		EOL
		1131	687		SOL Hinchinbrook Sea Valley to
	168	2038	687		EOL Resurrection Bay
July 8	168	2038			AR Seward
					End of Cruise

* Sat. Nav. - Satellite Navigation
**D.R. - Dead Reckoning

Table 2 Descriptions, locations and water depth of seafloor samples (R/V Sea Sounder S-1-76)

Sta. No.	Lat.	Long.	Water Depth (m)	Equip. Type *	Sample Descriptions
600A	57°59.9.9'N	136°42.0'W	112	VV	Pebby sandy mud
600B	"	"	150	VV	Pebby sandy mud, benthic organisms
601	58°05.8'N	136°45.8'W	215	VV	Grey-green mud, burrowed, benthic organisms
602	58°11.31'N	136°47.7'W	90	VV	Very fine sandy mud, burrowing, benthic organisms
603	58°10.7'N	136°56.7'W	184	VV	Olive green mud
604	58°13.7'N	137°04.7'W	120	VV	Pebbly sandy mud, benthic organisms
605	58°16.3'N	137°15.28'W	120	VV	Grey-green muddy sand, benthic organisms
606	58°25.0'N	137°27.2'W	185	VV	Olive gray mud, benthic organisms
607A	58°23.2'N	137°53.1'W	162	VV	Olive gray mud, burrowed
607B	58°22.9'N	137°53.6'W	162	GC	"
608	58°31.6'N	138°04.2'W	144	VV	Olive gray mud, burrows, benthic organisms
609	58°32.8'N	137°53.0'W	135	VV	Olive gray mud, benthic organisms
610	58°36.8'N	137°58.9'W	96	VV	"
611	58°32.5'N	137°44.9'W	138	VV	"
612B	58°30.6'N	137°37.6'W	178	VV	"
613	58°37.9'N	137°34.5'W	140	VV	Gray mud
614	58°38.6'N	137°36.3'W	41	VV	"
615	58°15.0'N	138°45.3'W		VV	Gray green mud over gray sandy mud, burrowed
616	58°14.9'N	138°42.4'W	163	VV	Silty clay over muddy sand
617	58°15.6'N	138°41.7'W	155	VV	Gray-green muddy sand
618	58°16.4'N	138°40.4'W	132	VV	"
619A	58°15.4'N	138°40.4'W	120	VV	Small recovery
619C	58°16.8'N	138°30.4'W	122	DC	Recovery
620	58°17.8'N	138°38.0'W	73	DC	
621	58°18.1'N	138°36.7'W	93	VV	Coarse sand and gravel
622	58°18.9'N	138°34.0'W	82	VV	"
627A	59°05.3'N	138°28.5'W	24	VV	Sand, mica, vk frags, burrows

* VV = Van Veen grab SPK = Shipek grab
GC = Gravity Core DC = Dart core

Table 2 **Descriptions, locations and water depth of seafloor samples (R/V Sea Sounder S-1-76)**

Sta. No.	Lat.	Long.	Water Depth (m)	Type	Sample Descriptions
628	59°05.6'N	138°29.1'W	11	VV	Gray sand, shells, rk. frags., benthic organisms
629	58°59.5'N	138°40.0'W	148	GC	Gray-green mud
630B	58°53.6'N	138°50.6'W	195	GC	Gray-mud
631A	?	?	18	VV	Sand
632	59°09.9'N	138°55.3'W	47	VV	Very fine sand
633	59°12.4'N	138°51.6'W	16	VV	Fine sand, benthic organisms, shells
634A	59°08.8'N	139°16.9'W	90	VV	Olive gray mud
634B	"	"	90	GC	45 cm. recovery
636	59°34.2'N	140°.1'W	218	VV	Gray green silt and silty sand
637	59°39.0'N	140°39.7'W	65	VV	Gray very fine sand, burrowed
638	59°38.1'N	140°40.8'W	48	VV	Gray fine salty sand
639	59°34.5'N	140°59.0'W	166	VV	Gray-green mud
640	59°37.5'N	141°06.0'W	70	VV	Gray clayey silt, burrows benthic organisms
641	59°44.2'N	141°10.5'W	30	VV	Gray sand, rk. frags.
642	59°01.3'N	141°20.2'W	61	VV	Gray very fine sand, burrows
643	59°36.5'N	141°20.0'W	95	VV	Clayey silt
644	59°32.8'N	141°23.0'W	134	VV	"
645	59°59.3'N	141°22.1'W	45	VV	"
646	59°59.9'N	141°25.1'W	70	VV	Muddy sand, benthic organisms
647	60°01.0'N	141°21.8'W	99	VV	Gray mud, benthic organisms
648	60°03.5'N	141°22.1'W	139	VV	"
649	60°04.7'N	141°22.0'W	146	VV	Mud with rk. frags.
650	60°05.4'N	141°21.4'W	122	VV	Gray mud
651	60°05.7'N	141°20.4'W	59	VV	"
652	60°06.3'N	141°16.3'W	138	VV	"
653	60°04.7'N	141°19.6'W	20	VV	Gray sandy mud with pebbles
654	60°00.5'N	141°19.5'W	66	VV	Pebbly mud
655	59°59.4'N	141°21.1'W	16	VV	Gray mud, rk. frags.
656A	59°54.0'N	143°39.3'W	277	VV	Gray mud
656B	"	"	"	GC	

Table 2 Descriptions, locations and water depth of seafloor samples (R/V Sea Sounder S-1-76)

Sta. No.	Lat.	Long.	Water Depth (m)	Type	Sample Descriptions
657A	59°55.5'N	143°35.2'W	265	VV	Gray mud
657B	"	"	"	GC	Small recovery
658A	59°47.2'N	144°28.8'W	74	VV	Gray mud
658B	"	"	"	GC	
659A	59°49.4'N	144°28.0'W	55	VV	Gray mud
659B	59°48.9'N	144°28.4'	54	GC	
660A	60°07.7'N	144°44.0W	34	VV	Gray sand
660B	60°07.9'N	144°40.5'W	34	VV	"
660C	60°08.0'N	144°40.8'W	34	SPK	"
661	60°06.2'N	144°40.3'W	70	VV	Gray mud
662	60°07.4N	144°37.8'W	40	VV	Fine sand
663A	60°10.8N	144°55.2'W	16	VV	"
663B	60°11.0'N	144°55.7'W	18	VV	"
664	60°04.4'N	145°00.2'W	95	VV	Clayey silt, burrowed
665A	60°08.2'N	145°00.0'W	42	VV	Muddy sand, shells, burrows
665B	60°08.5'N	145°00.2'W	45	VV	Muddy sand
666	60°00.0'N	145°04.5'W	116	VV	Gray mud, burrows
667	59°58.1'N	145°50.0'W	85	VV	Gray mud, burrowed
668	59°49.6'N	146°13.0'W	62	VV	Shell hash
669	60°04.3'N	146°09.5'W	70	VV	Sandy pebbly mud, benthic organisms

Table 3 Seafloor Characteristics at Television Stations (R/V Sea Sounder S-1-76)

Camera Station	Depth Range (m)	Bottom Character	Ripple Marks	Other Surface Features	Benthos
JD/Time (GMT) Start Lat./Long. End Lat./Long.		MS-muddy sand SM-sandy mud M-mud S-sand Sh-shell hash	Sym-symetric L-Linguoid Asym-Asymetric λ -wavelength Amp-amplitude R-relic, poor definition M-modern, sharply defined	MDS-mounded, undulating B-burrows S-scarps C-cover of pebbles, cobbles T-tracks from organisms	Sp-sea peas *-starfish, urchins, sand dollars A-anenomes EF-encrusting flora C-crabs
TV 1 167/ 60°08.0' 144°40.8'	34	S	Sym, M λ= 15 cm amp < 5-10 cm	B	Sp, C
TV 2	118-125	M, MS	Sym, R	B, T, S	
TV 3	50-62	M, SM	Sym, M λ= 5 cm amp $\leq$ 3 cm	B, S, T	Sp, C
TV 4 167/0740-0755 60°11.0'N 144°55.7'W	18-20	S	Asym, M λ= 7-8 cm amp $\leq$ 6 cm		
TV 5 167/1321-1350 60°04.4' 145°00.2'	96-100	M		B	Sp
TV 6 167/2034-2120 59°58.8' 145°46.2'	87-90	M		B, Mds, T	*
TV 7 168/0100-0154 59°49.6' 146°13.0'	56-60	Sh, S, SM		Mds, S, C	Sp, *, A, Ef, C

Table 3 Seafloor Characteristics at Television Stations (R/V Sea Sounder S-1-76)

Camera Station	Depth Range (m)	Bottom Character	Ripple Marks	Other Surface Features	Benthos
JD/Time (GMT) Start Lat./Long. End Lat./Long.		MS-muddy sand SM-sandy mud M-mud S-sand Sh-shell hash	Sym-symetric L-Linguoid Asym-Asymetric λ -wavelength Amp-amplitude R-relic, poor definition M-modern, sharply defined	MDS-mounded, undulating B-burrows S-scarps C-cover of pebbles, cobbles T-tracks from organisms	Sp-sea peas *-starfish, urchins, sand dollars A-anenomes EF-encrusting flora C-crabs
TV 8 168/0400-0502 60°04.3' 146°09.5'	68-71	SM		C, Mds	Ef, *, Sp, C
TV 9 168/0730-0746 60°13.0' 146°44.7' Ed: 60°13.0' 146°44.5'	225	M		B, T	*
TV 10 168/0847-0920 St. 60°07.3' 146° 45.9' Ed: 60°07.7' 146°46.0'	99-122	M		Mds, B, T	Sp, *, C
TV 11 168/1105-1126	71-72	SM, M		C	Ef, *, Sp

TABLE 4 Description of bottom camera stations.

Bottom Camera Stations - S1-76-EG

Station	Location	Frames	Water Depth	Description
624	58°19' 138°31'	6	60 m	Soft muddy bottom, some cobble cover, dense brittle star cover, organism tracks and burrows. Slightly over exposed.
627B	Start: 59°05.3' 138° 28.5' end: 59°05.1' 138°29.4'	13	23 m	Subparallel ripple sets, discontinuous crests, symmetric, low amplitude, no organisms. Most out of focus, overexposed.
630A	Start: 58°53.7' 138°50.6' end: 58°53.6' 138°50.6'	19	193 m	Soft muddy bottom, many burrows, some tracks. Slightly overexposed.

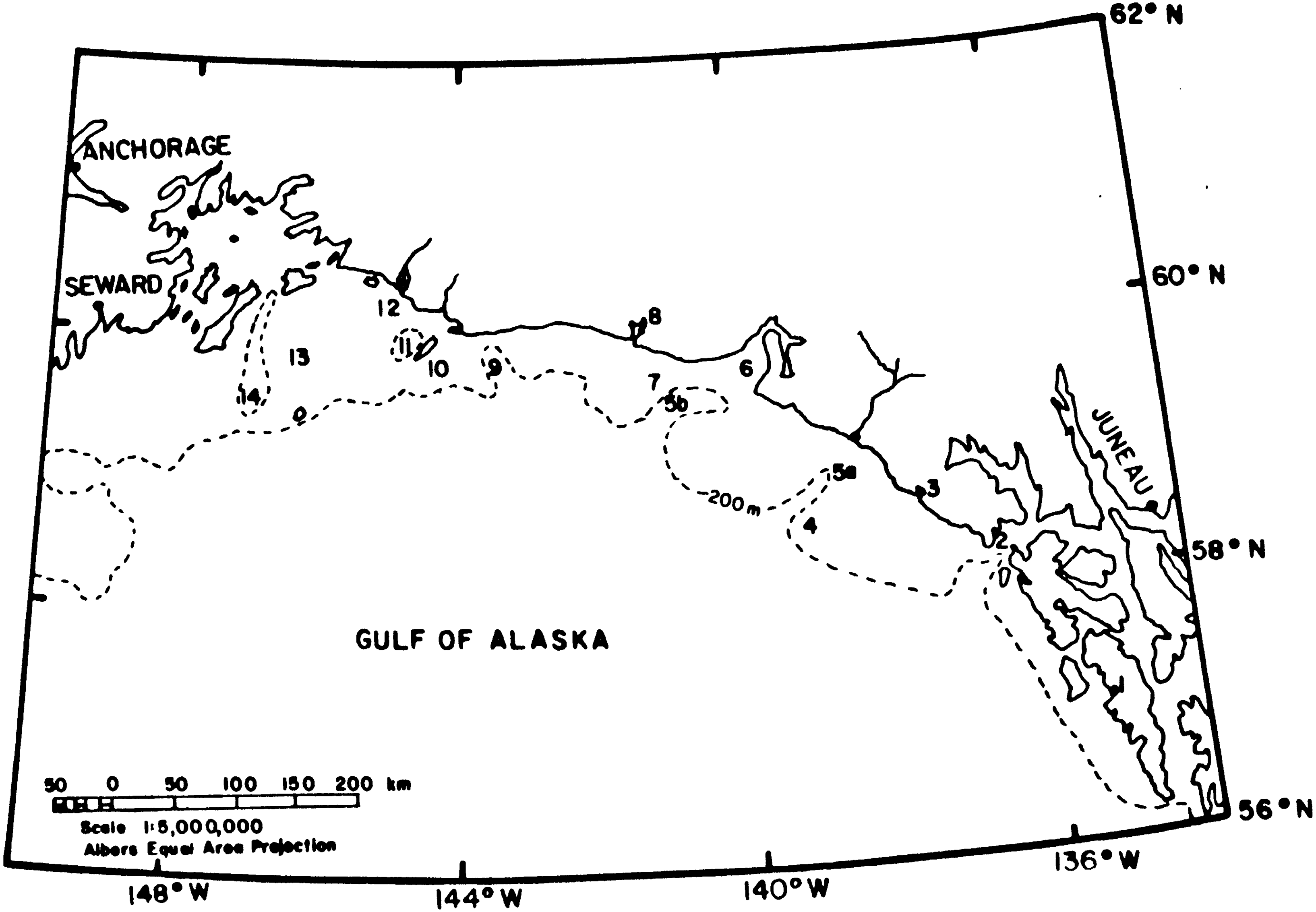

Figure 1. Sketch map of eastern Gulf of Alaska showing the geographic areas visited. The numbers coincide with the areas discussed in sections 1-14. (1) Sitka, (2) Cross Sound, (3) Lituya Bay, (4) Fairweather Ground, (5a) Alsek Sea Valley, (5b) Yakutat Sea Valley, (6) Yakutat Bay, (7) Malaspina Glacier nearshore area, (8) Icy Bay, (9) Bering Trough, (10) Kayak Island east, (11) Kayak Trough, (12) Copper River prodelta, (13) Tarr Bank, (14) Hinchinbrook Sea Valley. Dashed line is 200 m isobath.

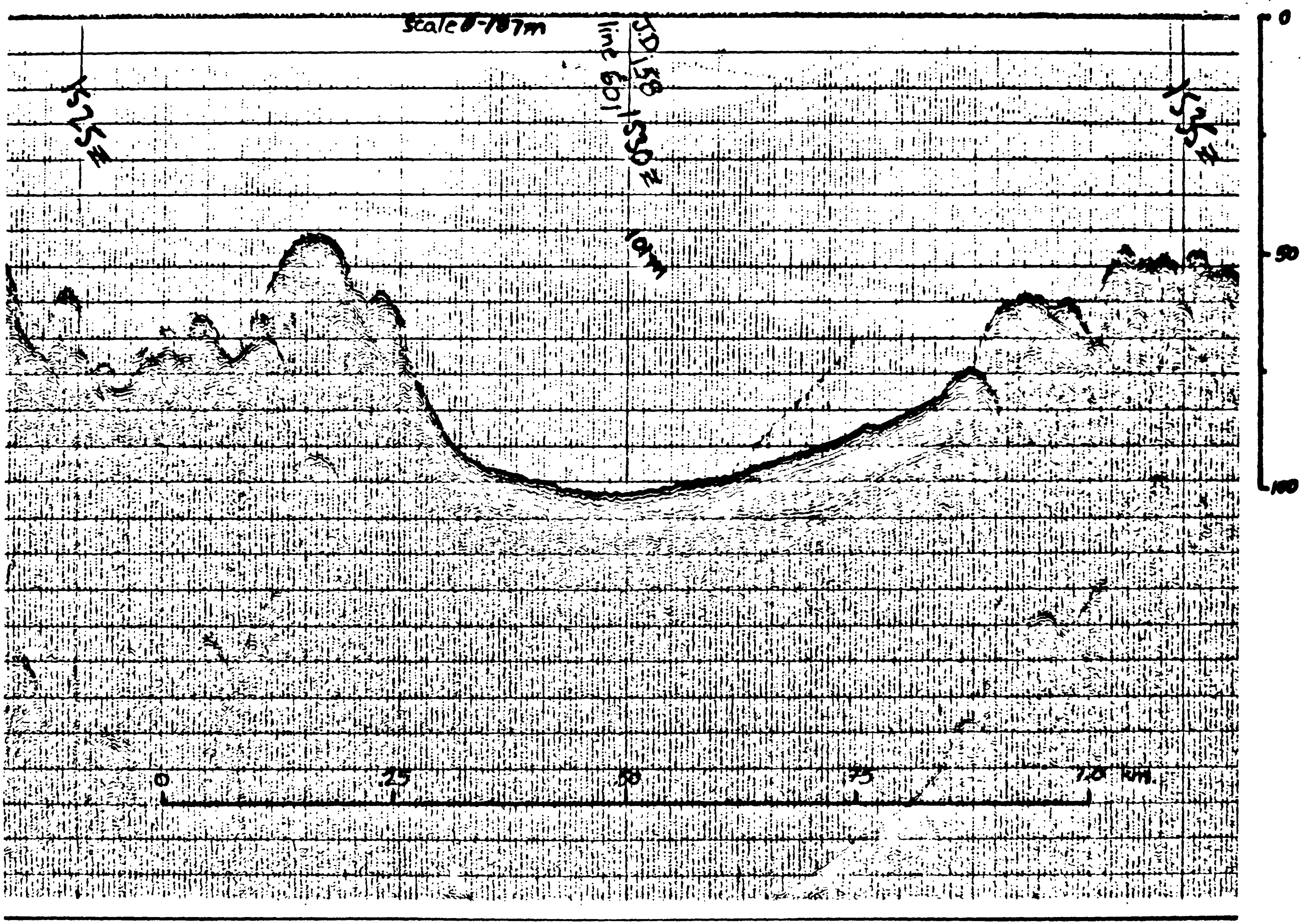

Figure 2. Example of annotated seismic record: J.D. - Julian Day, Z = Greenwich Time, Depth in meters based on 1500 m/sec speed of sound in water.

U.S.G.S. ACOUSTIC EQUIPMENT LOG: LEG 1 EQUIP. TYPE Uniboom PAGE 34 OF 65

LOCATOR SEA 1 - 76 - EG (COL. 73-80) (I.D. – YR. – AREA) TOW DIST./DEPTH: SOURCE ____ RECEIVER ____ SHIP Sea Sounder

RECORDER TYPE/NO. EPC 4100 CHIEF SCIENTIST Molnia & Carlson

Reel chg	Julian Day	GMT Hr.-Min.	Sec.	Line No.	Shot Point	Media/Spec. Code (3 lett's)	Data/Equip Code (4 letters) (Archive No.)	Roll on Reel No. (4 let./no.)	S/E of Roll, Reel: Strt	S/E of Roll, Reel: End	Data/Syst Recording: On	Data/Syst Recording: Off	Comments	Course	Speed	Water Depth	Recorder: Scale	Recorder: Sweep	Recorder: Shoot	Filters: High	Filters: Low	Power
	162	2250		629		PAP	UNIB	12					RE Elias 2. APQ	000	5.7	194	141-328	1/4	1/4	714	180	600
		2300											RE	045	5.7	190						
		2310											RE	046	5.8	188						
		2320											RE	44	5.7	177						
		2330											RE at 2325 Re-Sync. Mark	046	5.8	168						
		2340											RE	046	5.8	158						
		2350											RE	44	5.7	147						
[illegible]	162	2354		629		PAP	UNIB	12			X	X	End line 629 Making turn				141-328	1/4	1/4	714	180	600
[illegible]	162	2358		630		PAP	UNIB	12					Start line 630 c/s	136	5.8	147	141-328	1/4	1/4	714	180	600
	163	0000											RE	133	6.4	148						
		0010											RE	131	6.2	180						
		0020											RE	132	6.4	211						
		9030											RE	136	6.3	235						
		9040											ReSync. Mark Paper [illegible]	132	6.3	256						
	163	0044		630		PAP	UNIB	12					change Key				187-375	1/4	1/4	714	180	600
	1-3	5-8	9,10	12-15	16-19	21-23	25-28	29-32	37	38	39	40										

* PLEASE RIGHT-JUSTIFY THESE ENTRIES

** DO NOT ENTER ST/END OF LINE ON THIS FORM (FOR KEYPUNCHING)

[illegible form number]

Figure 3. Example of shipboard seismic log for Uniboom system. Similar logs were kept for 3.5 kHz and 90 KJ sparker systems.

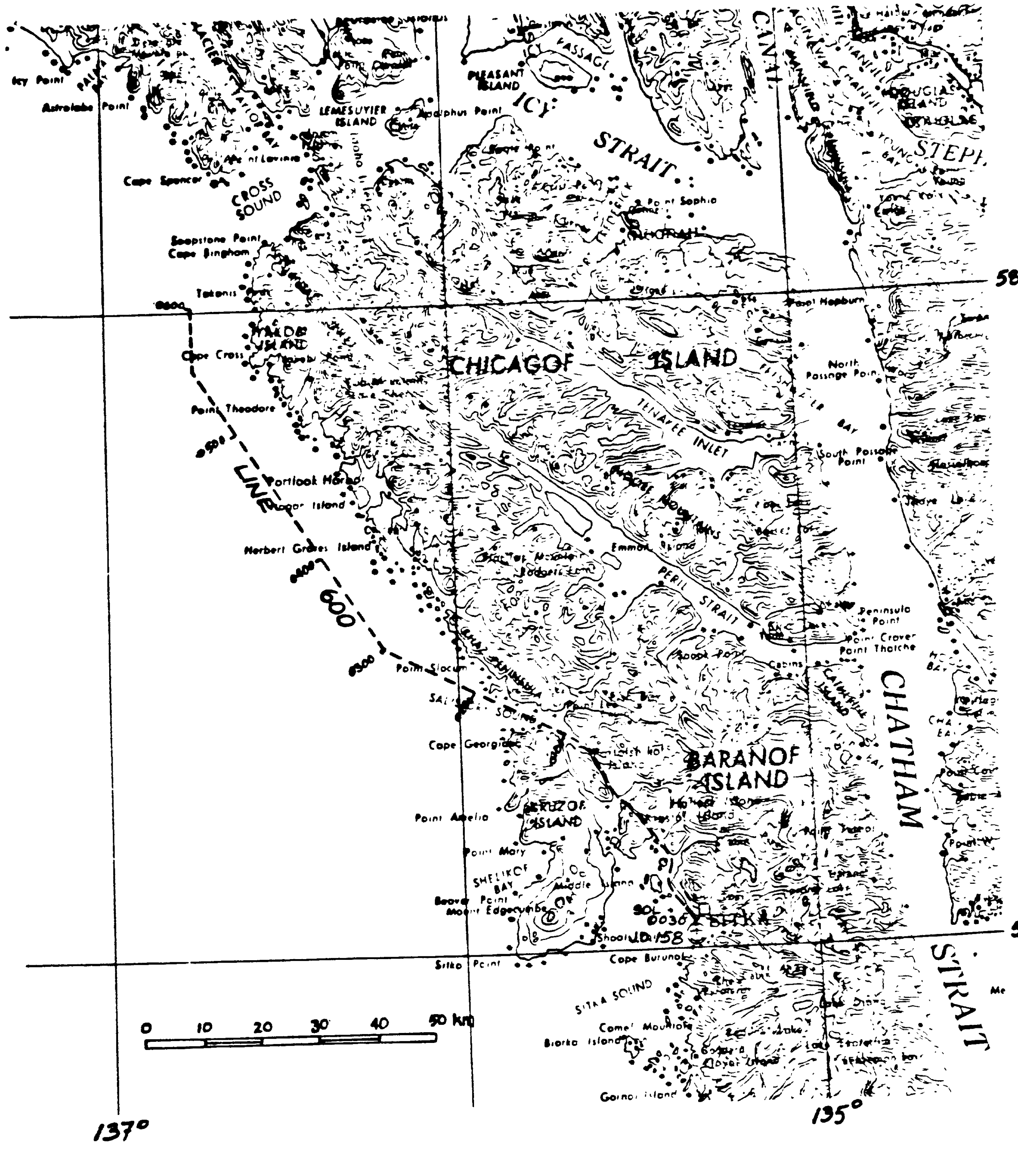

Figure 4. Trackline 600: Sitka to Cross Sound. Only the 3.5 kHz system was used. Base map from USGS 1,000,000 Topographic Series, Sitka, 1956.

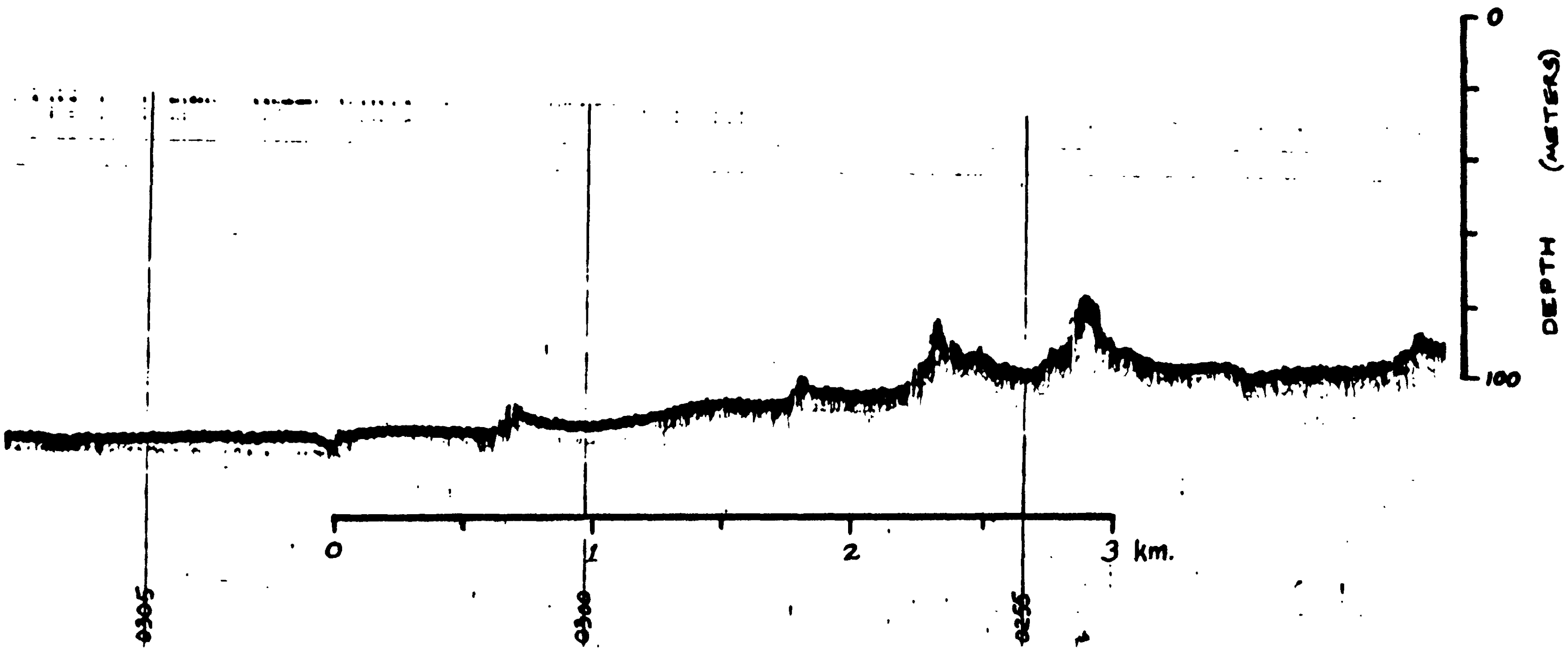

Figure 5. 3.5 kHz profile (600) off Baranof Island. See Figure 4 for location. Note the change in morphology at about 0300 hrs. Vertical exaggeration (V.E.) $\sim$ 10x.

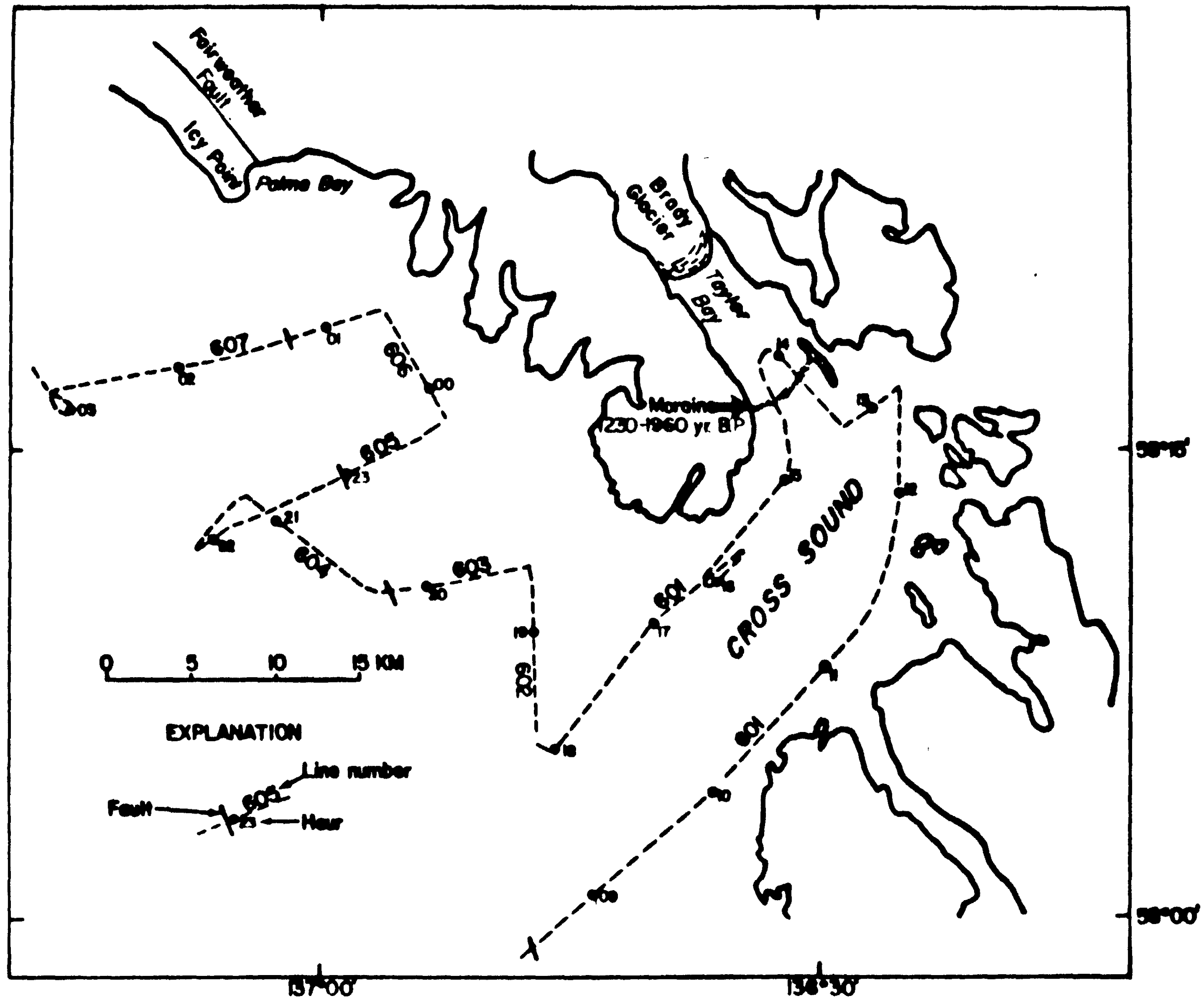

Figure 6. Track lines in Cross Sound, Taylor and Palma Bays showing locations of Brady Glacier end moraine and fault scarps associated with Fairweather Fault system.

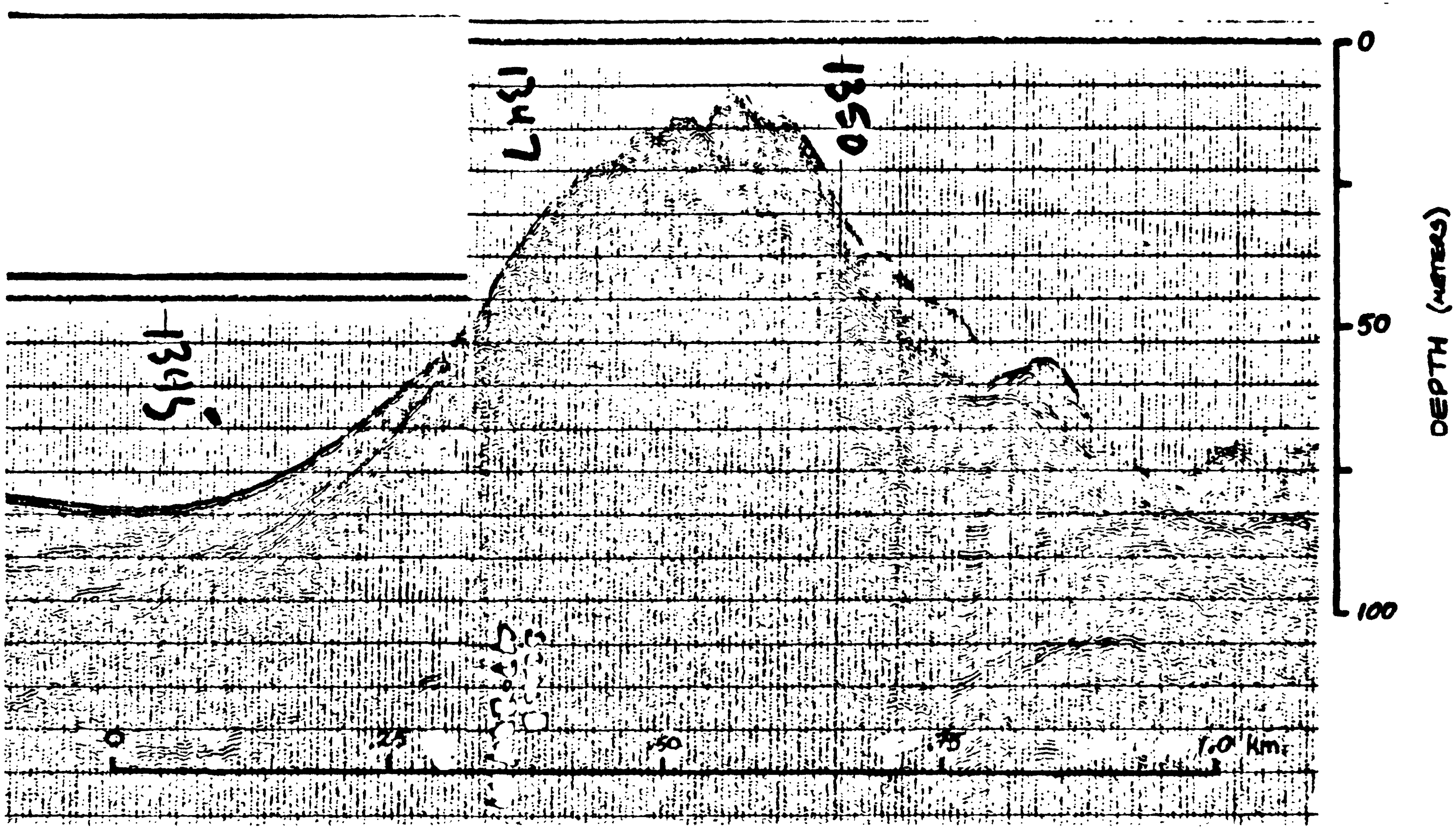

Figure 7. Uniboom profile (601) across Brady Glacier end moraine, east side of Taylor Bay. v.e. $\sim$ 10x.

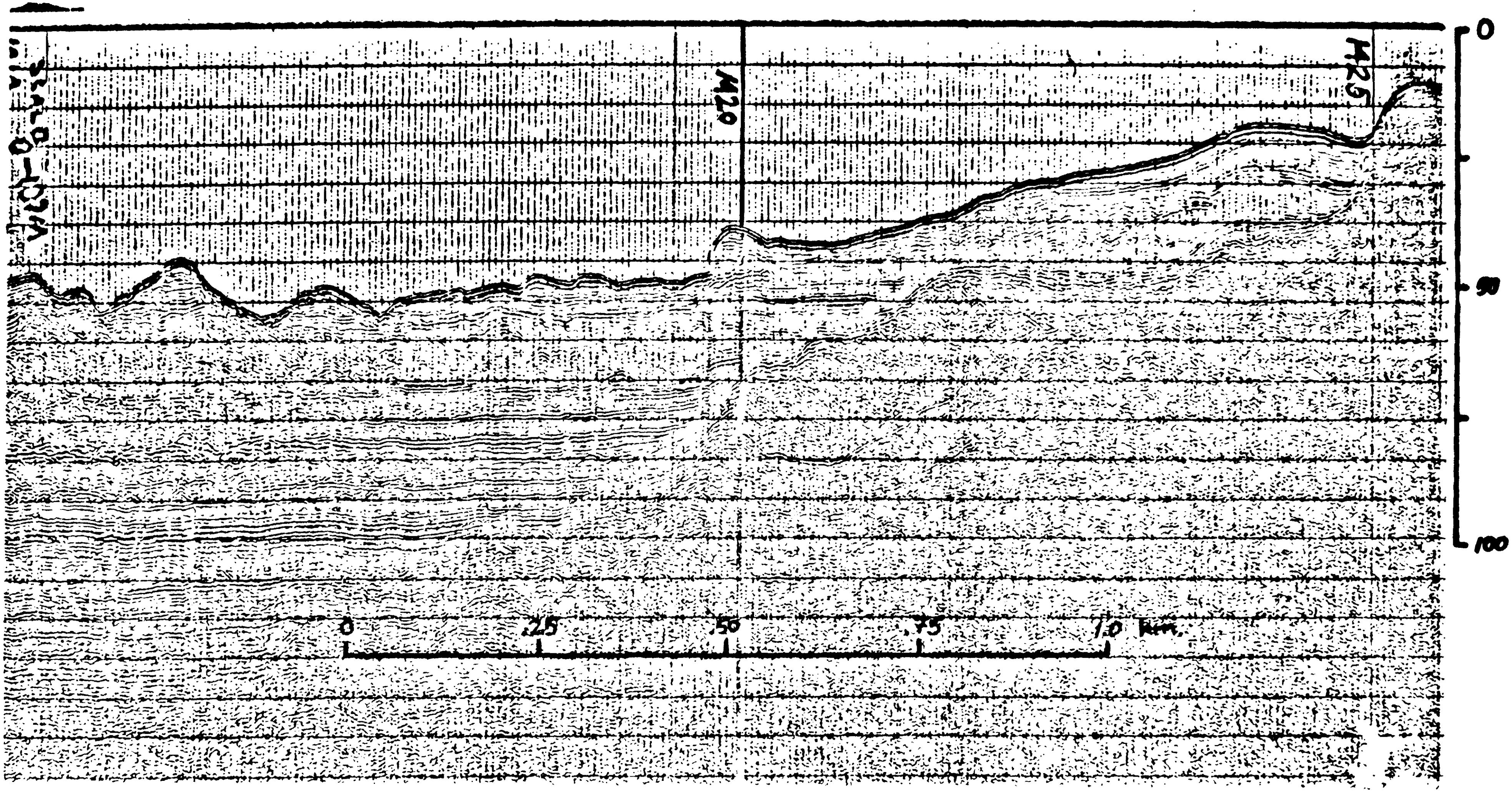

Figure 8. Uniboom profile (601) over sediment ponded behind Brady Glacier end moraine, west side of Taylor Bay. Note large bed forms at left 1/4 of profile and moraine at extreme right. v.e. ~ 10x.

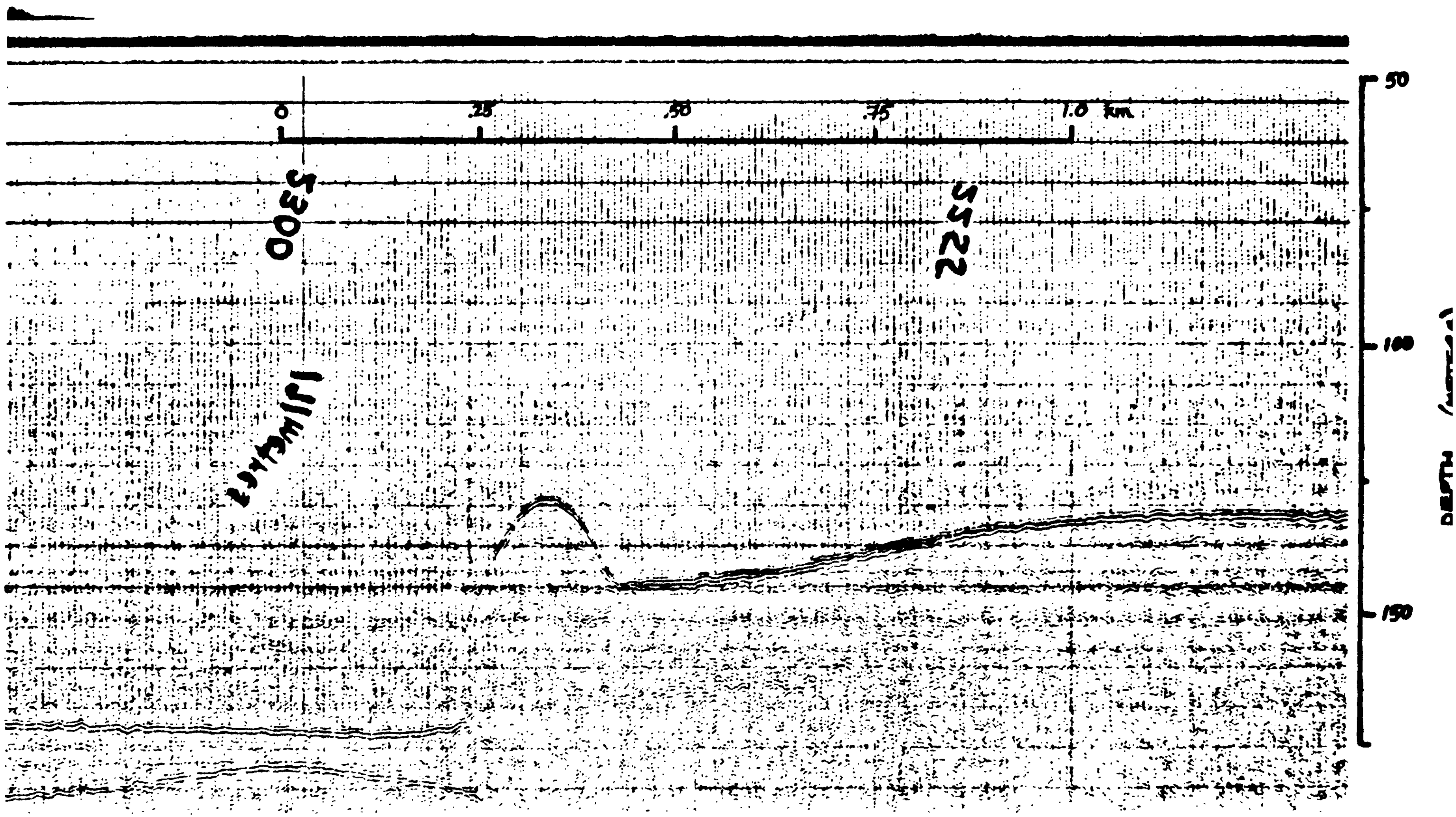

Figure 9. Uniboom profile (605) across Fairweather Fault scarp, south of Palma Bay (see Fig. 6). v.e. $\sim$ 10x.

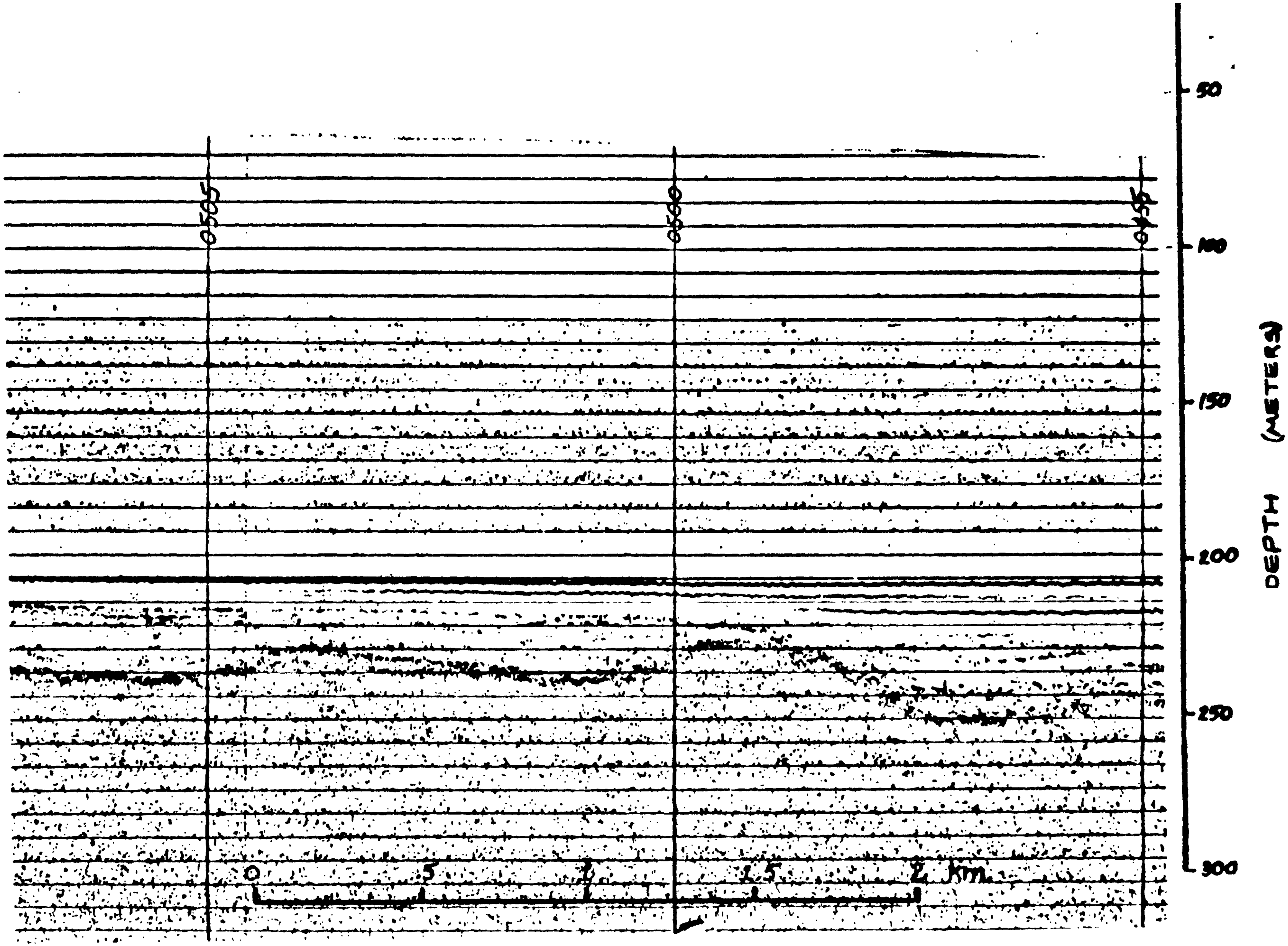

Figure 10. 3.5 kHz (609) profile off Lituya Bay showing buried erosion surface. v.e. ∼ 10x.

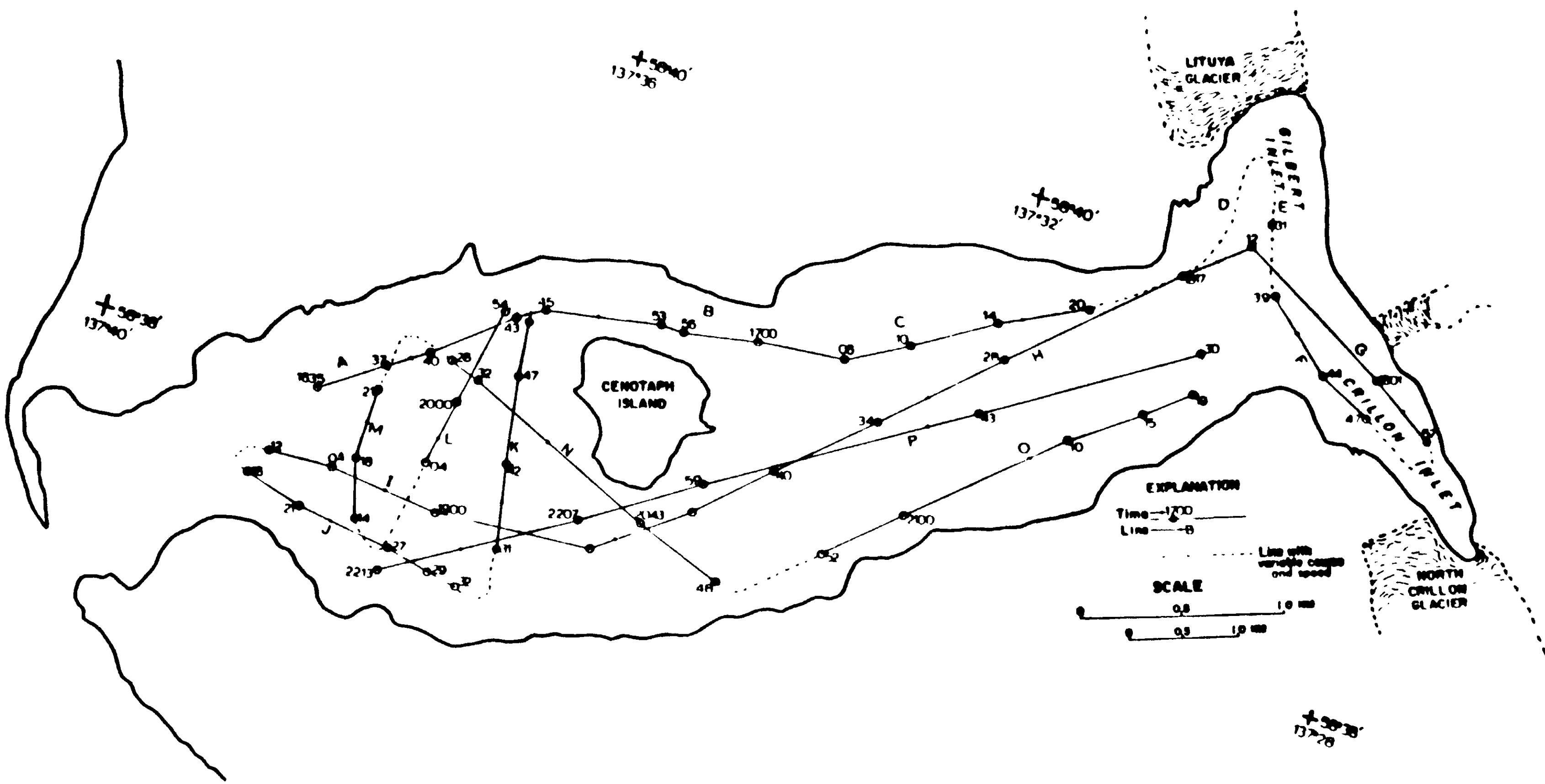

Figure 11. High resolution seismic reflection lines in Lituya Bay.

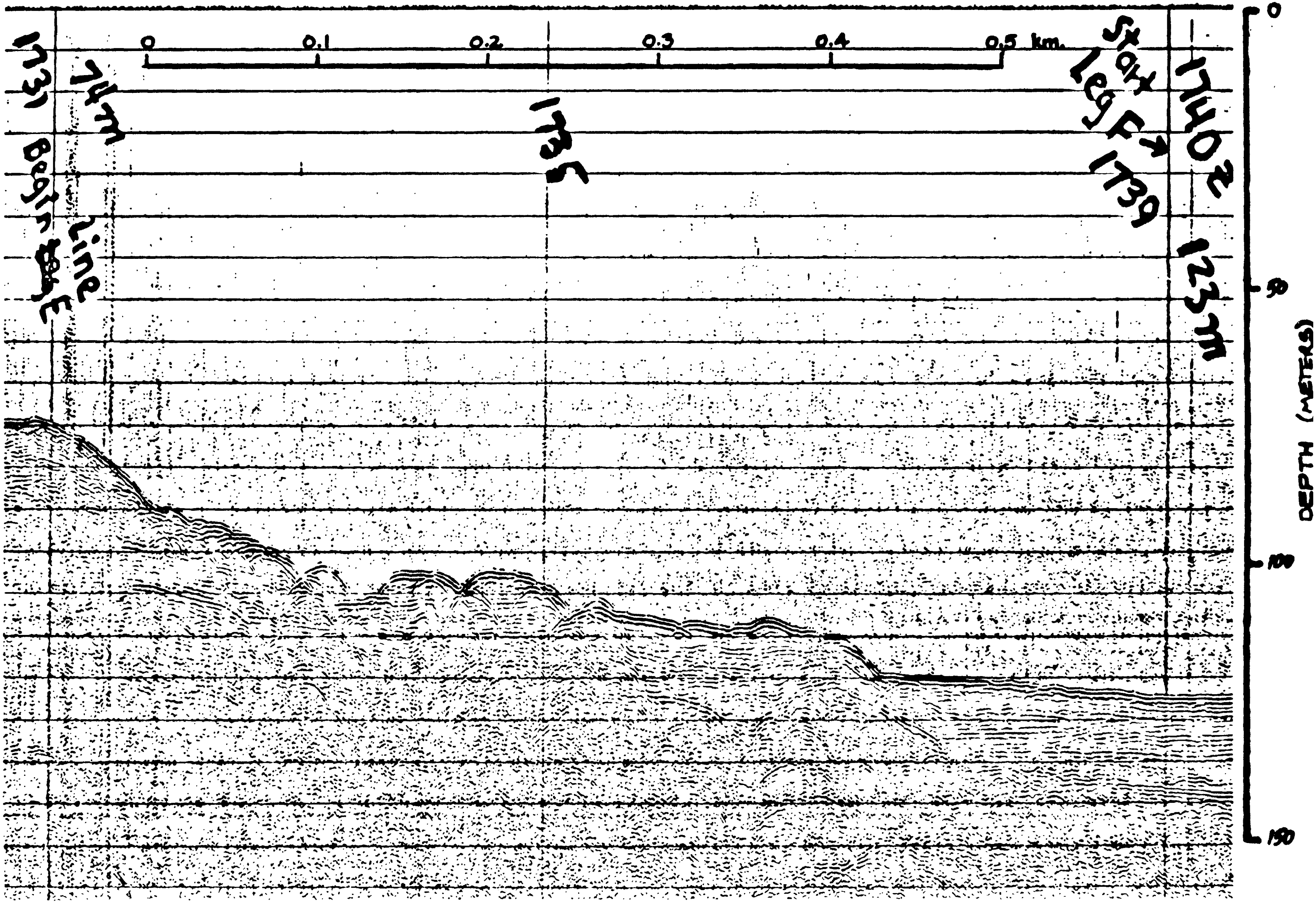

Figure 12. Uniboom profile (LBE) showing hummocky, slide-created morphology on the floor of Lituya Bay. v.e. ~ 10x.

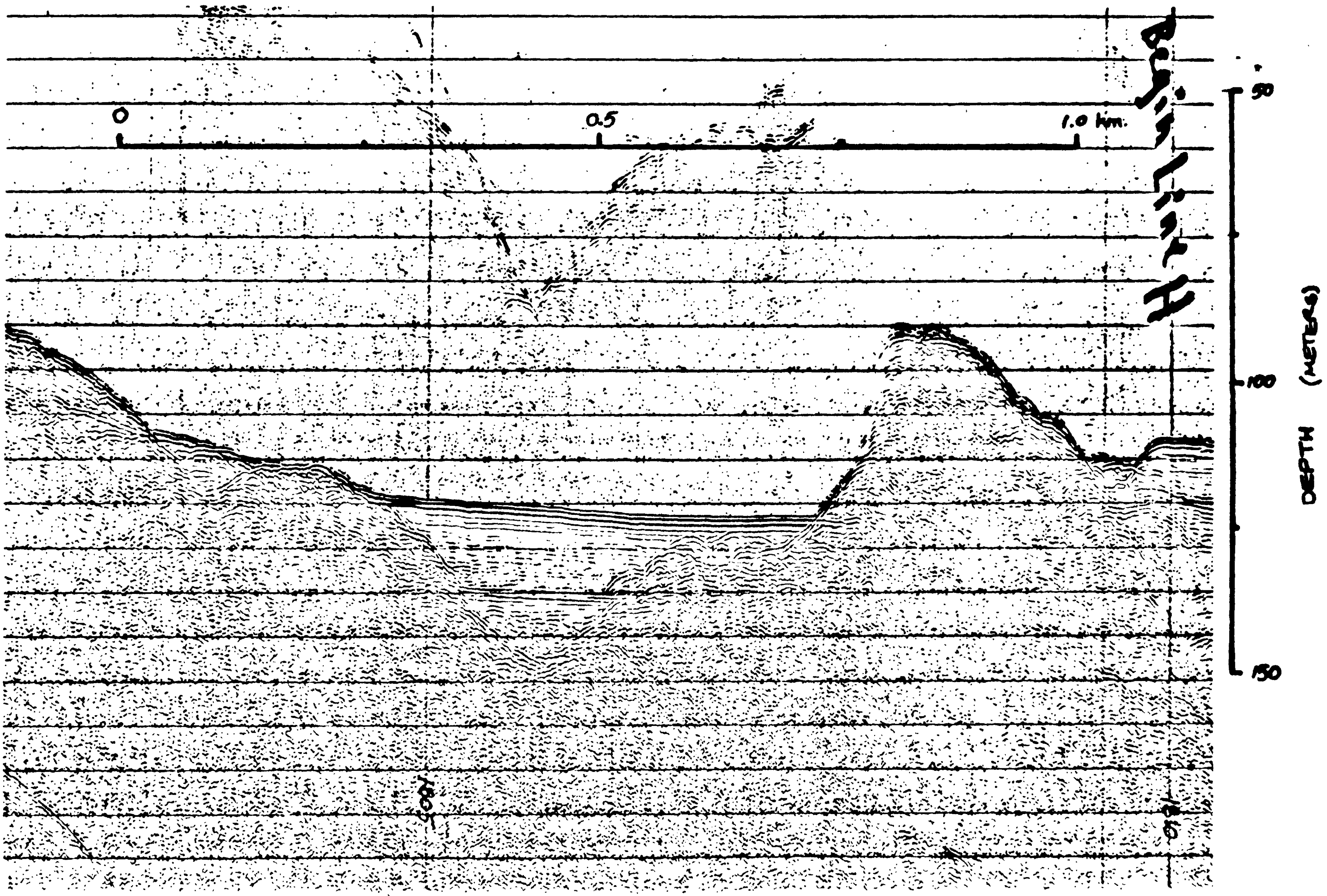

Figure 13. Uniboom profile (LBG) showing filled channels in Lituya Bay. v.e. ~ 10 x.

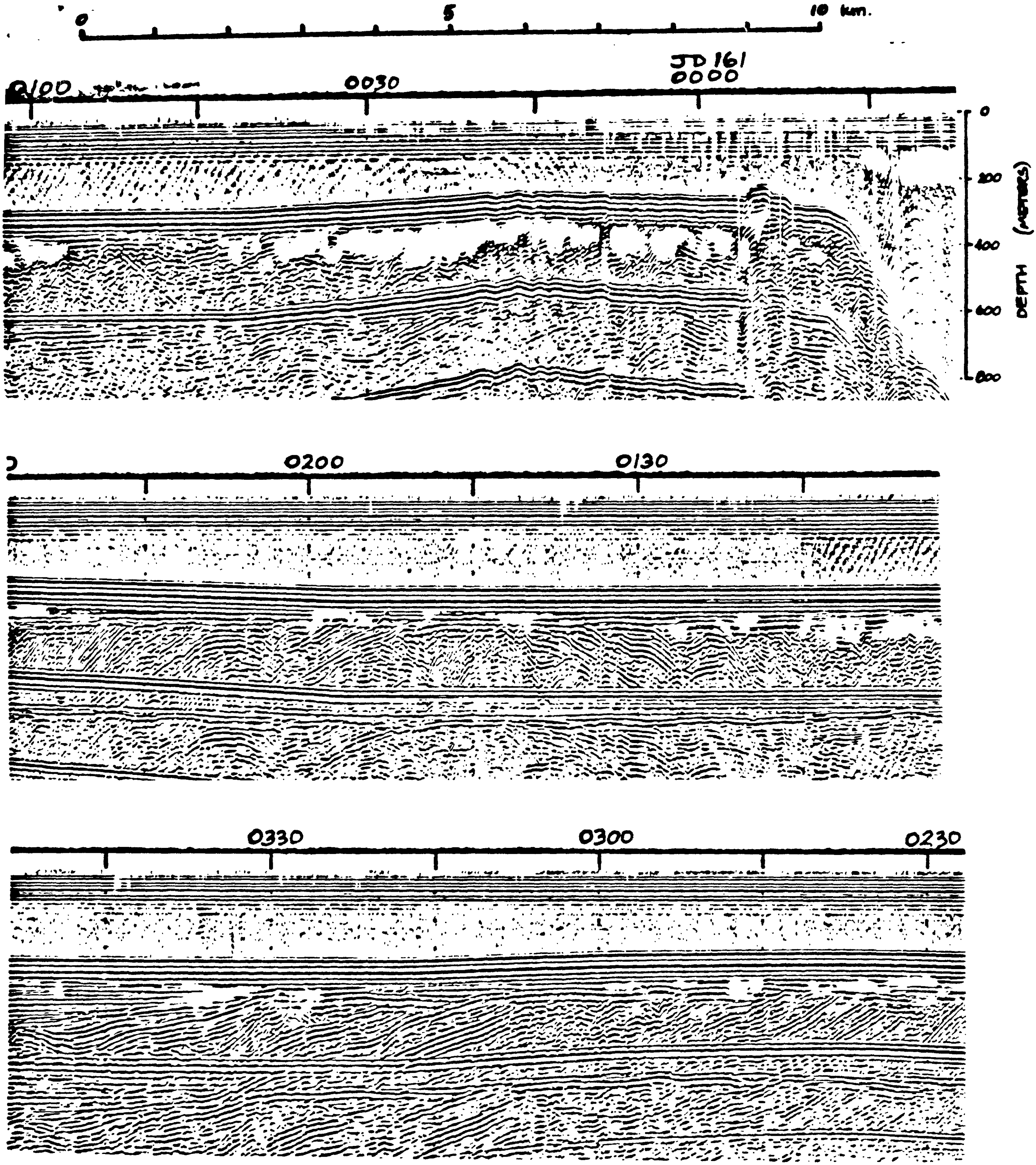

Figure 14. Three continuous sections of a 90 KJ sparker profile (line 620) along axis of outer Alsek Sea Valley. v.e. ~ 10x.

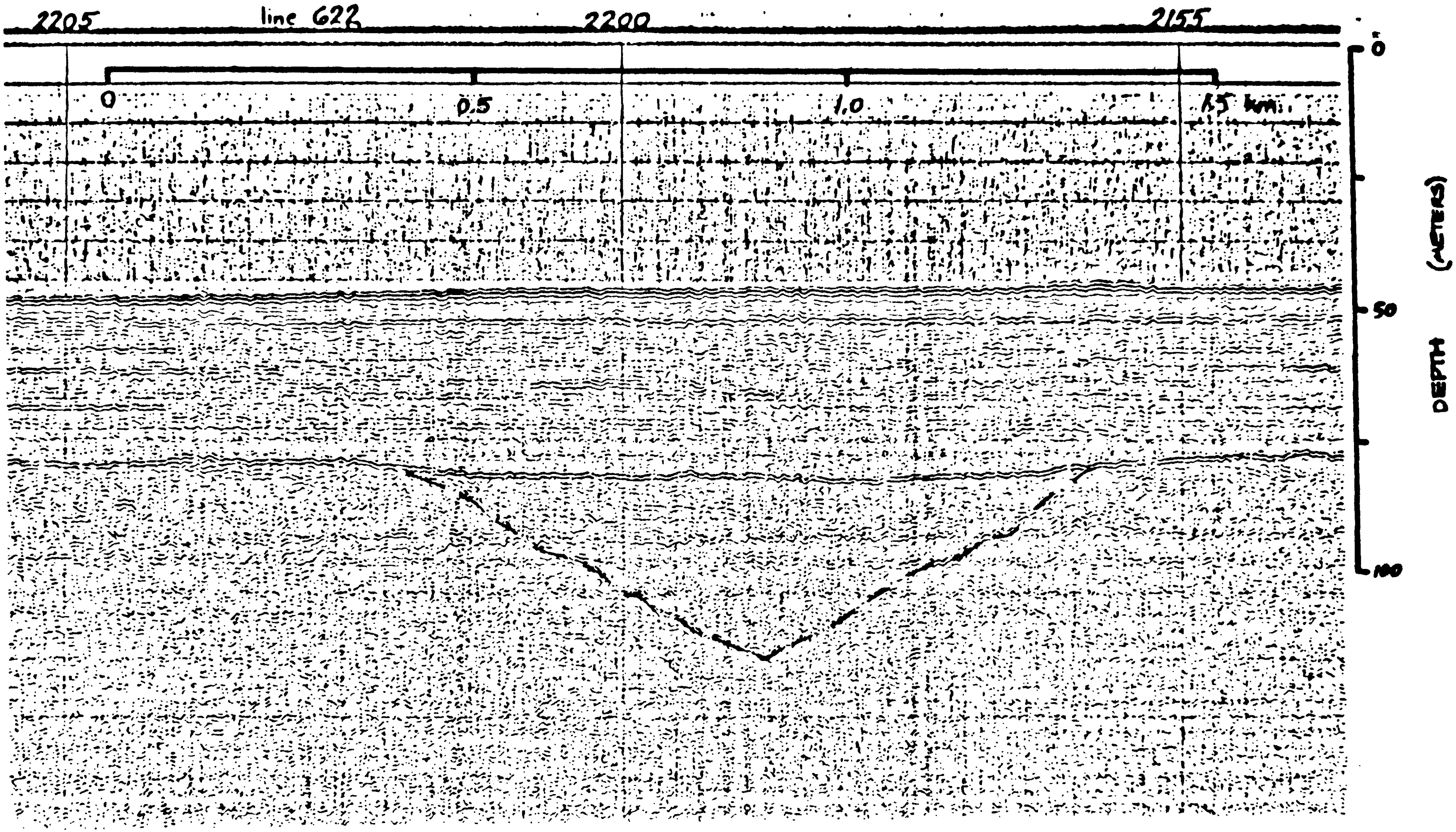

Figure 15. Uniboom profile (622) showing buried channel seaward of Dry Bay.
Outline of channel shown by dashed line added for emphasis.

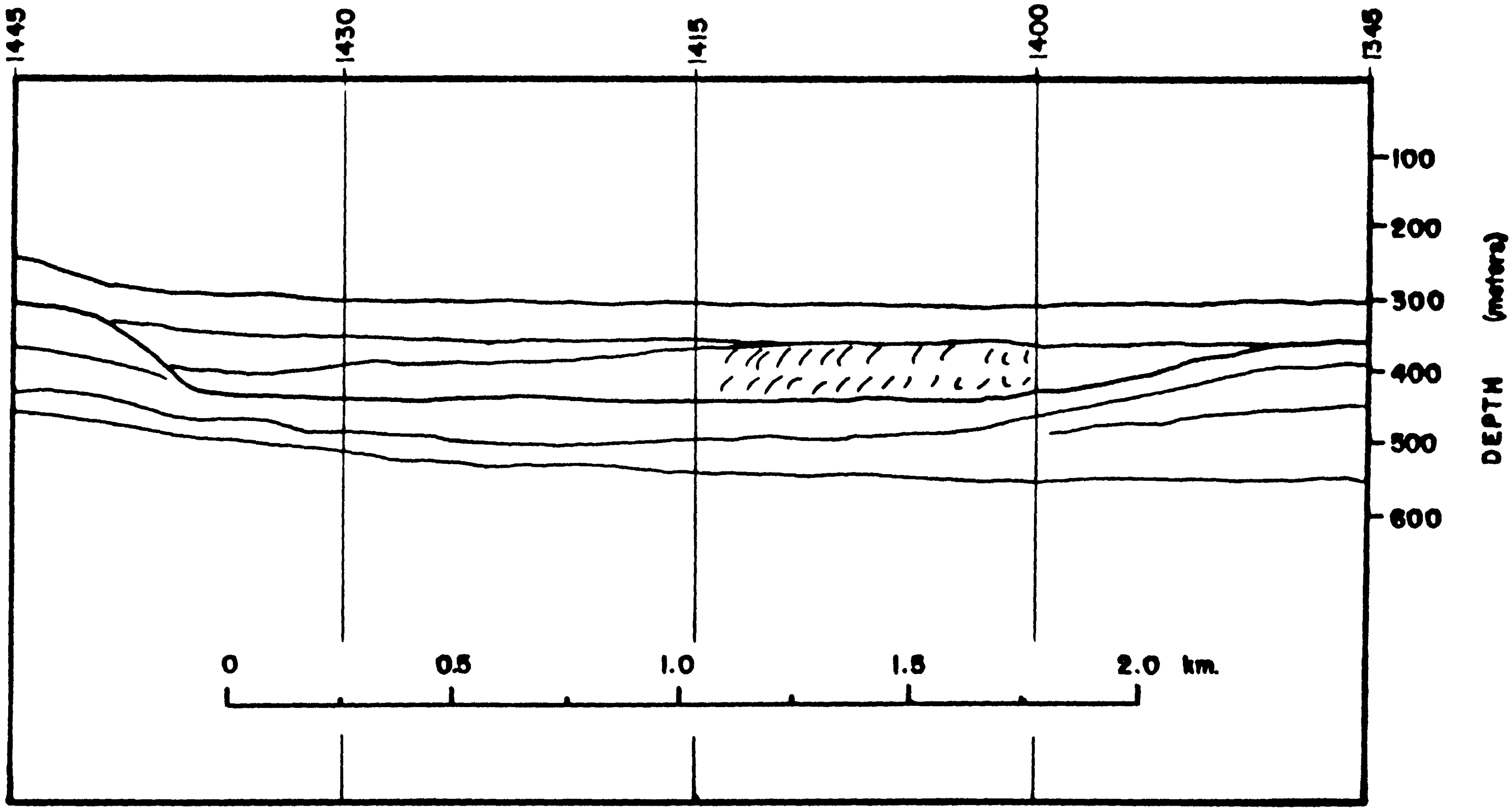

Figure 16. Sketch of reflectors on 90 KJ sparker profile (625) showing buried channel in Yakutat Sea Valley. v.e. ∿ 10x.

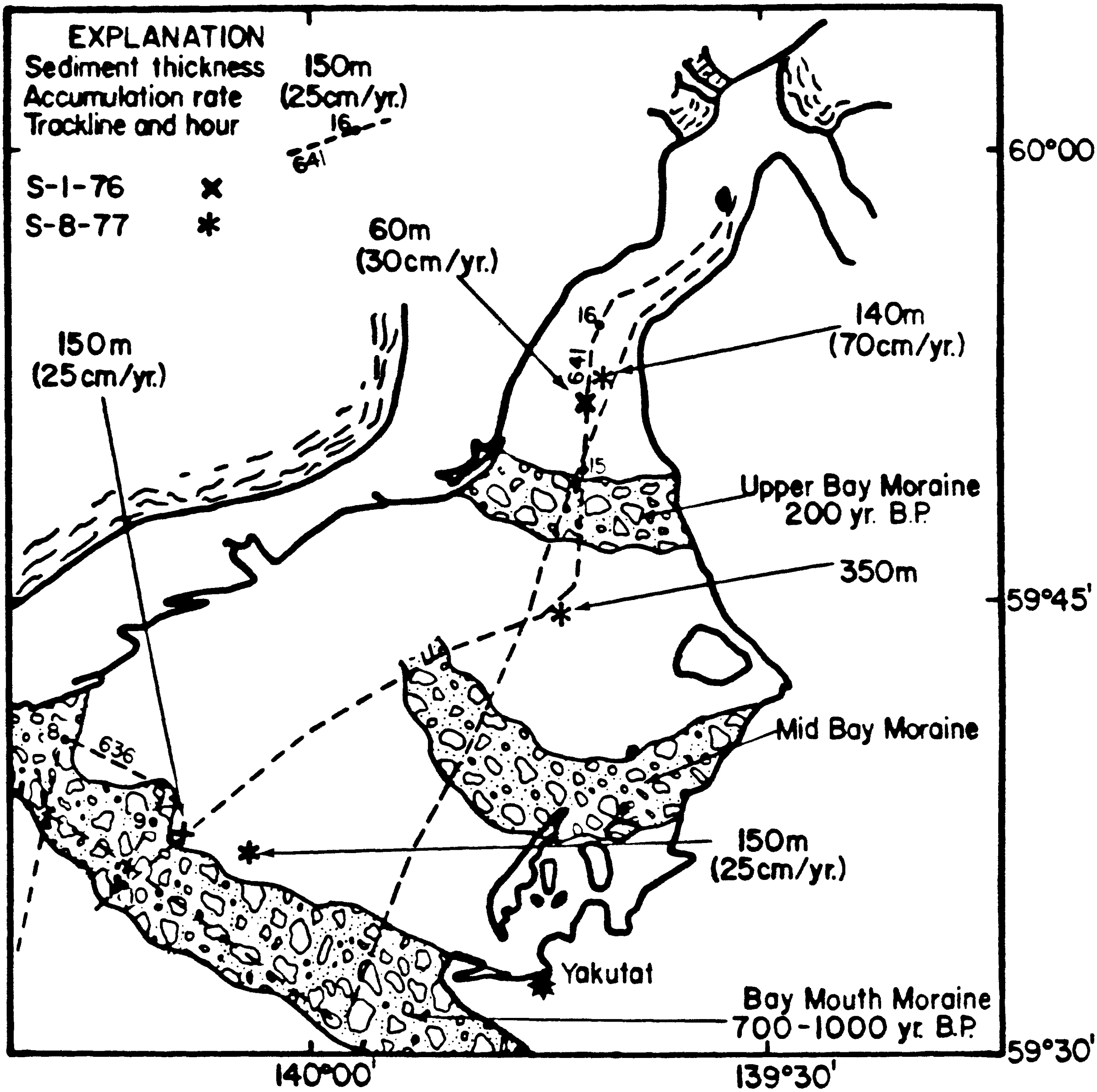

Figure 17. Yakutat Bay showing end moraines and rates of sediment accumulation. Rates are based on thicknesses of soft sediment overlying glacial till and the age assigned to the adjacent moraine.

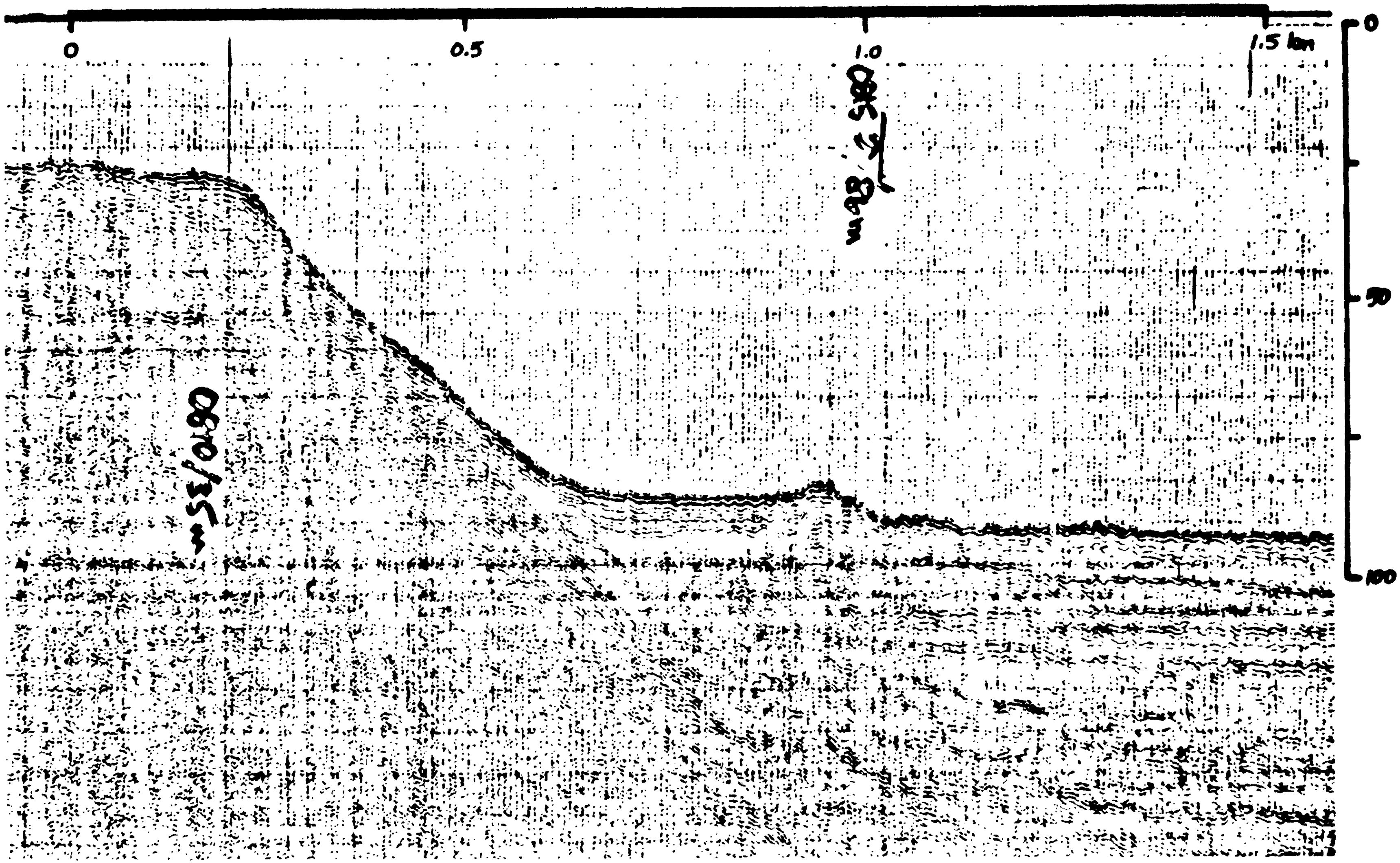

Figure 18. Uniboom profile (636) showing part of the Bay Mouth Moraine and an intramorainal basin. Note slump mass to left of center that appears to have come from the west wall of the moraine. v.e. ∿ 10x.

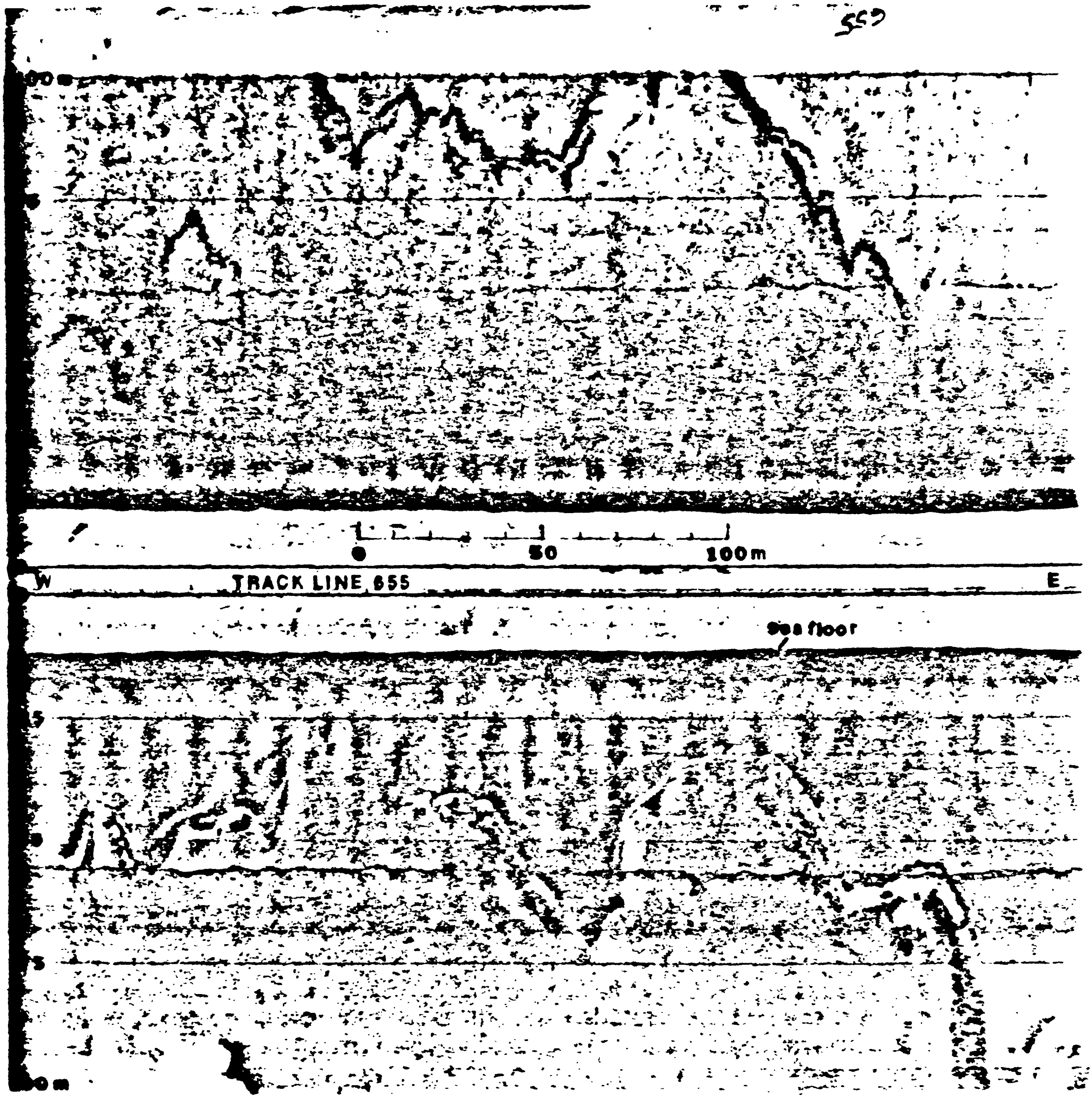

Figure 19. Side scan sonar profile (655) showing incipient slump scarps in Icy Bay - Malaspina Glacier slump.

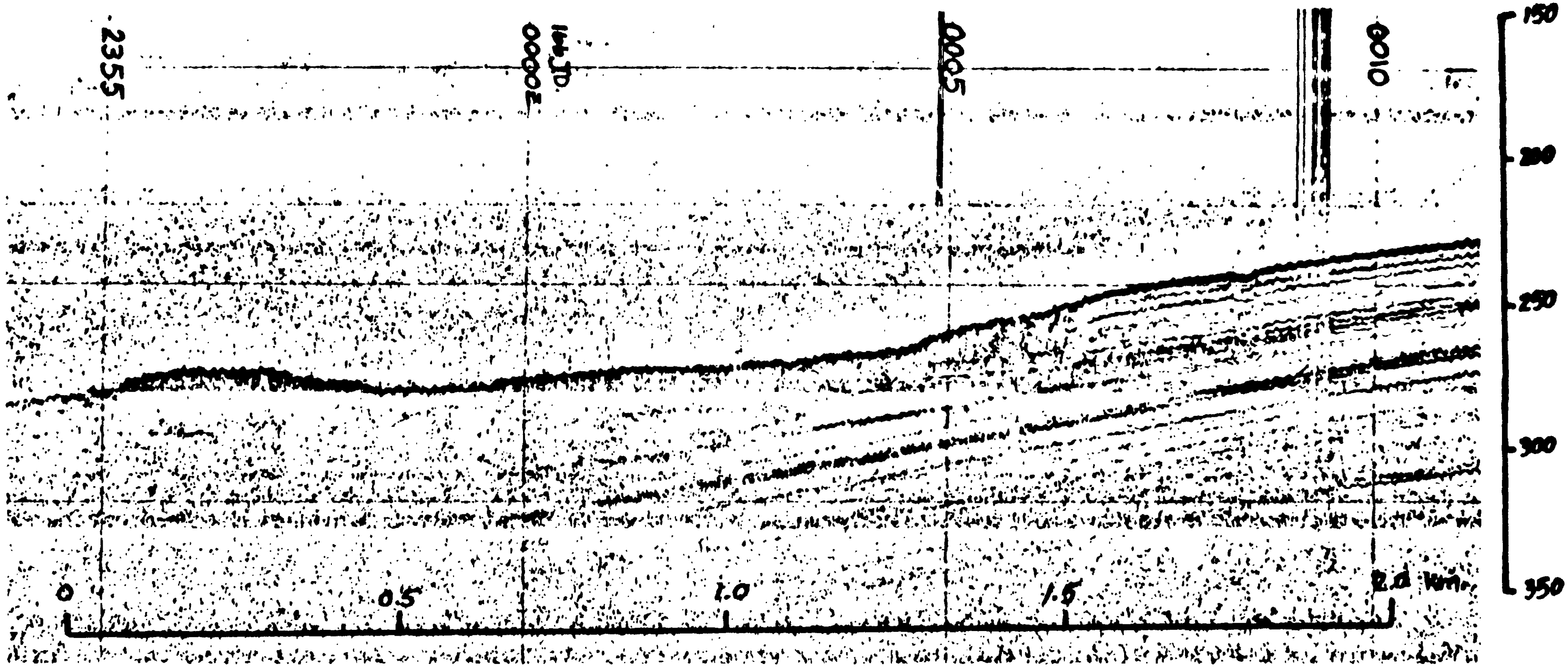

Figure 20. High resolution seismic (3.5 kHz) profile (664) in Bering Trough showing probable slump-related features. v.e. ~ 10x.

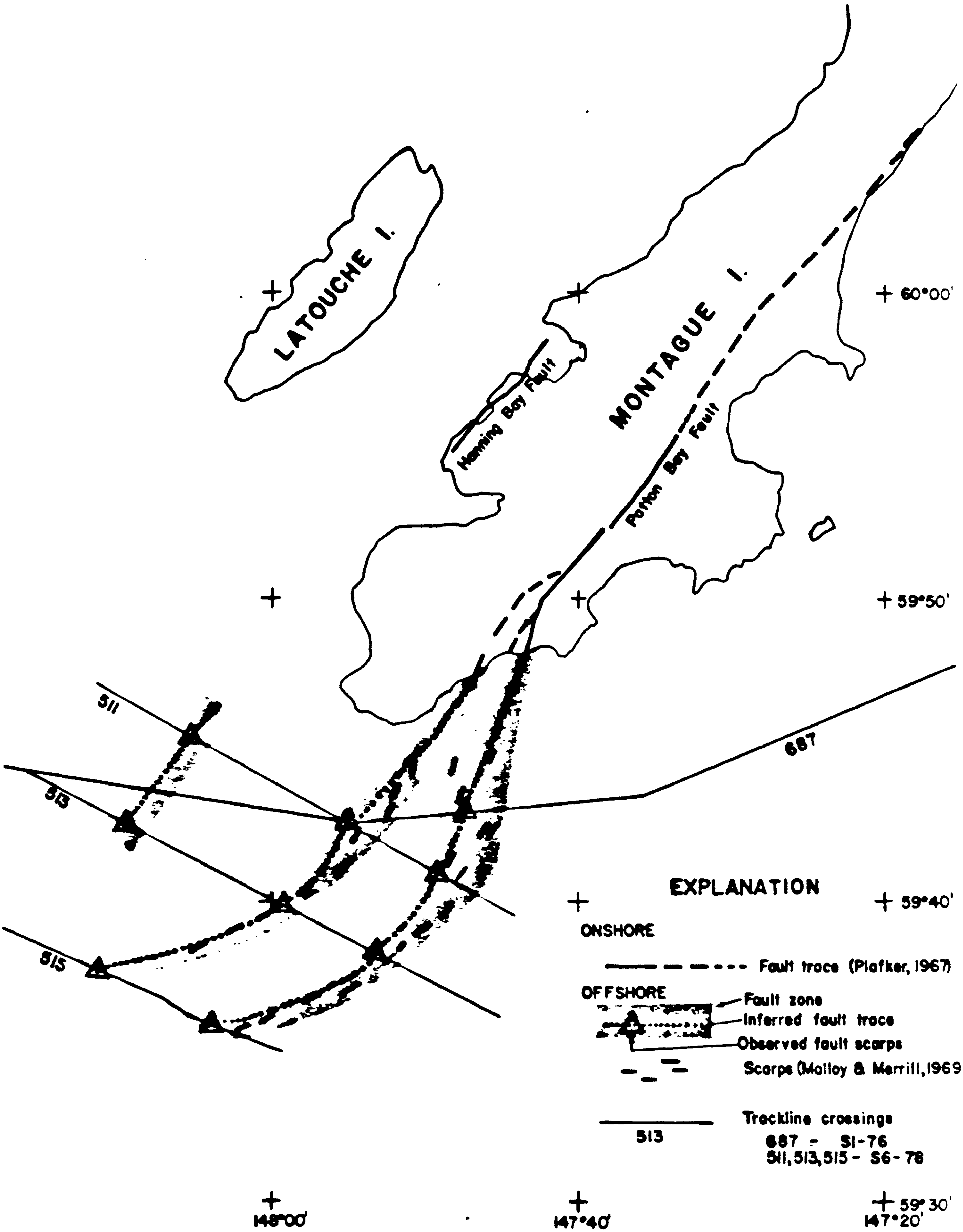

Figure 21. Seaward extension of the Patton Bay fault zone across the Montague Island platform.