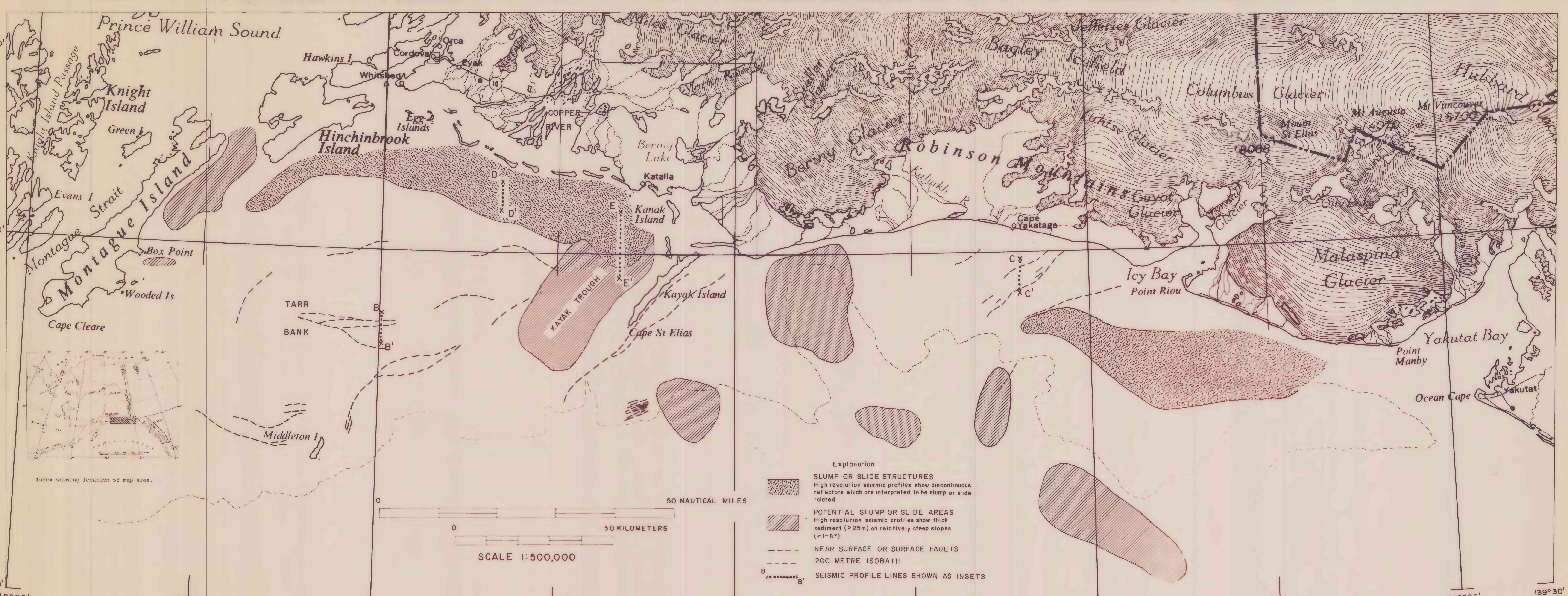

In the northern Gulf of Alaska, oil and gas leasing of the outer continental shelf (OCS) is proposed in the very near future (Dec. 1975). Because the region is subject to intense seismic activity (Page, 1975), it seems timely to delineate areas of the OCS which are susceptible to potential hazards from ground shaking, fault displacement or ground failure. Therefore the purpose of this map is to provide: (1) preliminary information regarding areas of present and potential submarine slides and/or slumps and, (2) approximate locations of nearsurface faults.

Data Collection

The data used for this map were collected on the September-October, 1974, cruise of the R/V THOMAS G. THOMPSON (von Huene and others, 1975). These data include three types of continuous acoustic profiles (inset A) using as sound sources a 3.5 kHz transducer, two minisparkers (800 Joules) and two 40 in^3 air guns. Several types of navigation equipment were used because of intermittent power and equipment failures: the instruments included Decca Hi Fix, Satellite, Loran A and Radar.

Nearsurface Faults

The traces of the nearsurface and surface faults were interpreted largely from minisparker records (insets B and C); airgun and 3.5 kHz records were used as additional aids.

In most cases the faults cut strata which are similar to and may be equivalent to the upper Yakataga Formation (inset B) which Plafker (1967) indicates is middle Miocene to lower Pleistocene. Often these strata are covered only by a thin veneer of Holocene sediment (inset C) and in many places crop out at the seafloor (inset B). A few of the faults appear to cut Holocene sediments (inset C). Additional interpretation of the age and sense of motion for these faults will not be attempted here--further study is needed.

The nearsurface faults we have thus far detected occur in four main parts of the OCS area: (1) south of Cape Yakataga, (2) on or adjacent to the Kayak Island platform, (3) on Tarr Bank and (4) near Middleton Island.

Slides and Potential Slides or Slumps

Seismic profiles from two parts of the map area show disrupted bedding and irregular topographic expression commonly associated with submarine slides or slumps (inset D and E). The slumped section south of Icy Bay and southwest of the Malaspina Glacier (about 1770 km^2 in surface area) has a gradual slope of less than 1/2°, but is in an area of thick Holocene sediment (>150 m).

Similarly the second area where slump structures were seen in the seismic records, an area of about 1730 km^2 along the Copper River prodelta, the slope is gentle (<1/2°), but a thick wedge of Holocene sediment (>200 m) has accumulated rapidly. According to Morgenstern (1967), in regions with high rates of sedimentation such as deltas, the lag between accumulation and consolidation gives rise to excess pore pressure and the sediment is thus weaker; such underconsolidated material is prone to slumping. The Copper River prodelta was investigated with seismic profiling equipment by Reimnitz (1972) shortly after the 1964 Alaska earthquake. He attributed the slump structures visible in the upper part of the section to this earthquake. These slump structures are similar in size and shape to the slump structures visible on our profiles over this same area (inset D).

Acoustic profiles show a massive submarine slide at the east edge of the Copper River (inset E). This 17 km long slide which has a volume of about $5.9 \times 10^{11} m^3$ (Carlson and Molnia, 1975) moved down a slope of about one degree to the bottom of Kayak Trough. Sediment samples collected from the upper metre of this slide consist of a structureless, gray silty clay of extremely low strength (laboratory tests with a vane shear yielded a peak shear strength of .02 kg/cm^2).

The areas on the map indicated as potential slide or slump zones were delineated based on thicknesses of Holocene sediment and relative steepness of slopes. Slump or slide features were not prominent on the profiles; however, because of the sediment thickness (>25 m) and slope steepness (>1-8°) there is a possibility of ground failure in these areas if a large earthquake provides rapid ground acceleration or if a large tsunami or storm wave disrupts the seafloor. Such catastrophic events were experienced by many communities in the Prince William Sound region and along the shoreline of the Gulf of Alaska during the 1964 Alaska earthquake (Grantz and others, 1964; Coulter and Migliaccio, 1966; and Plafker and others, 1969).

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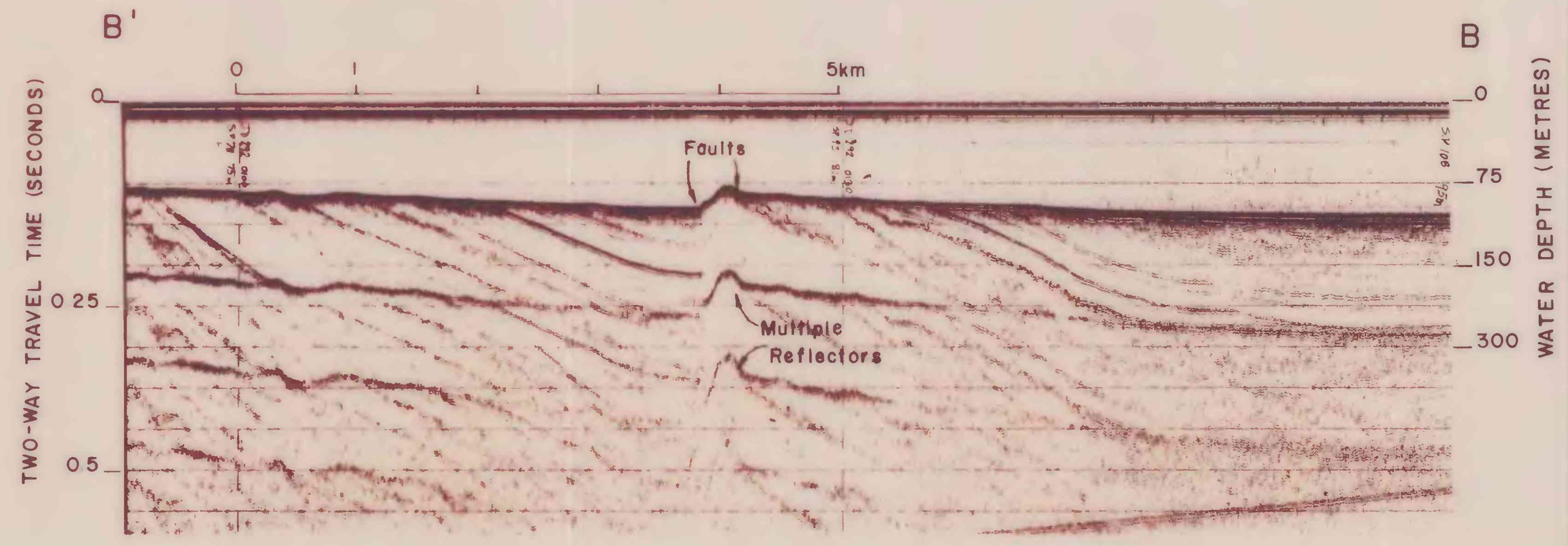
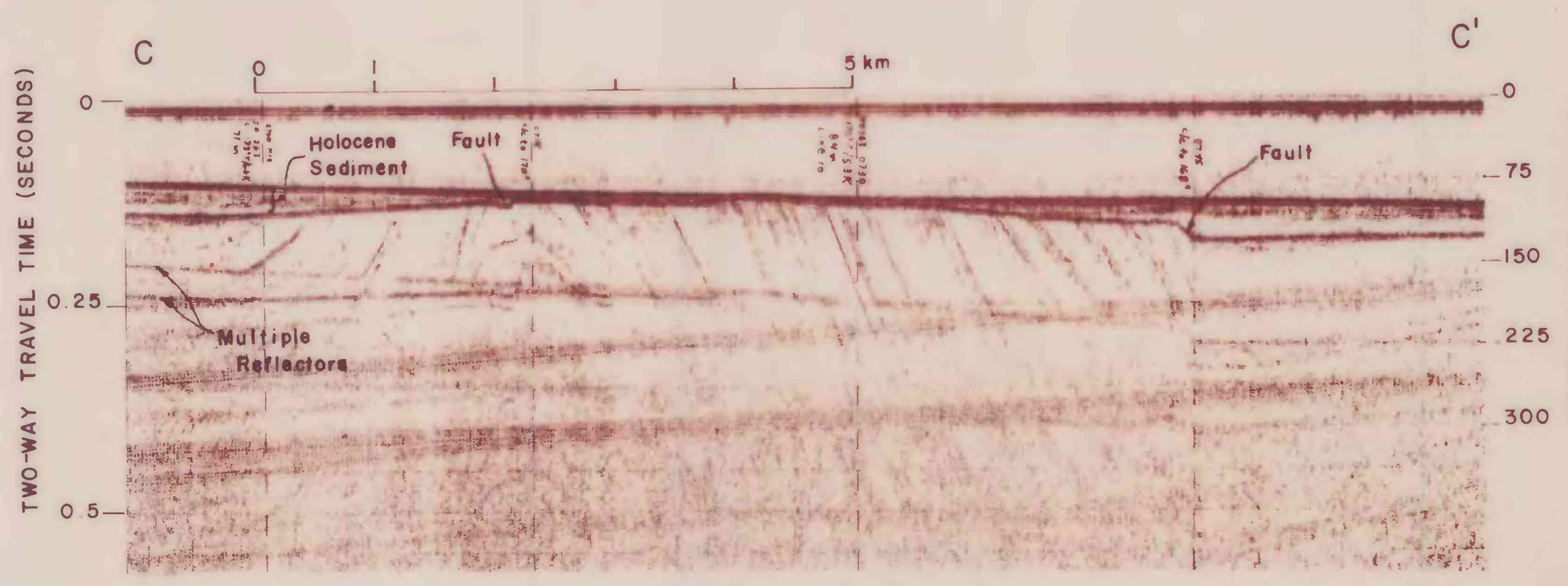
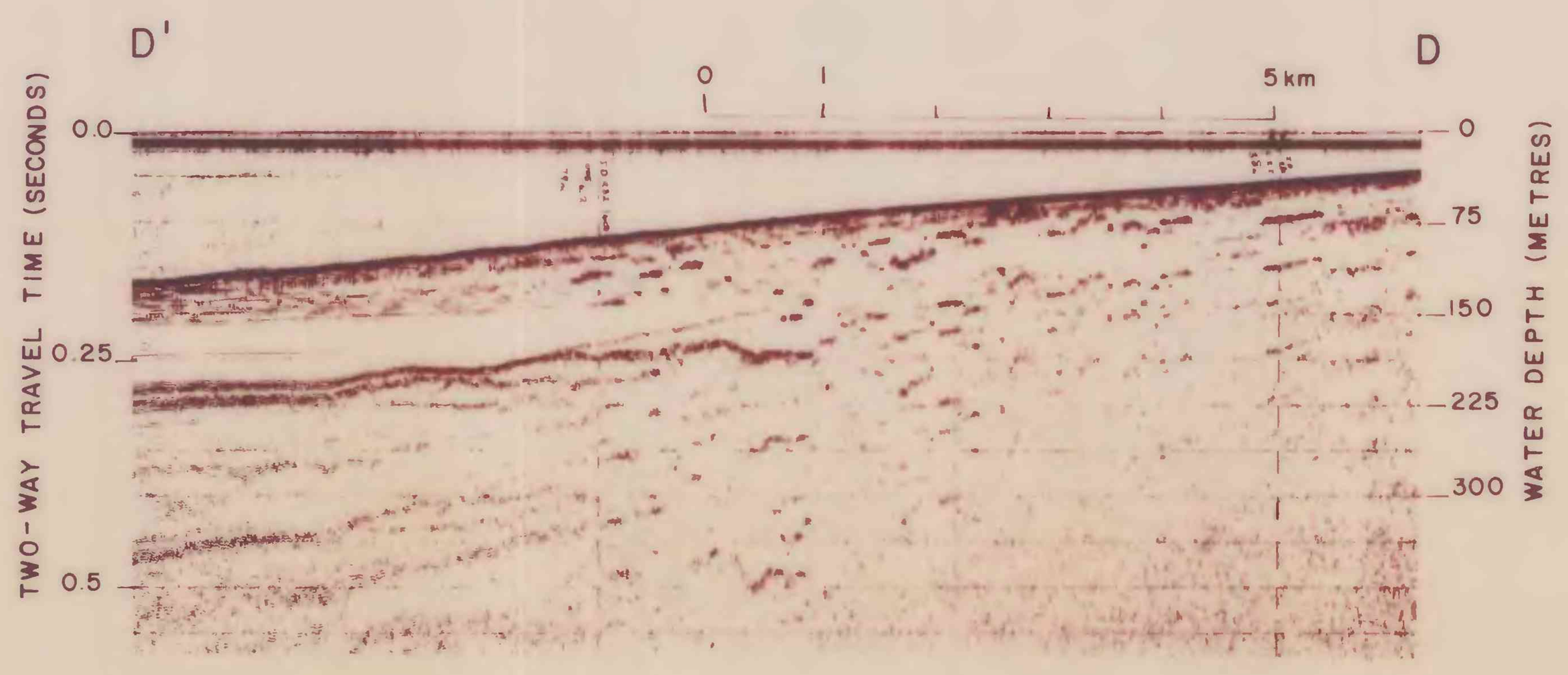


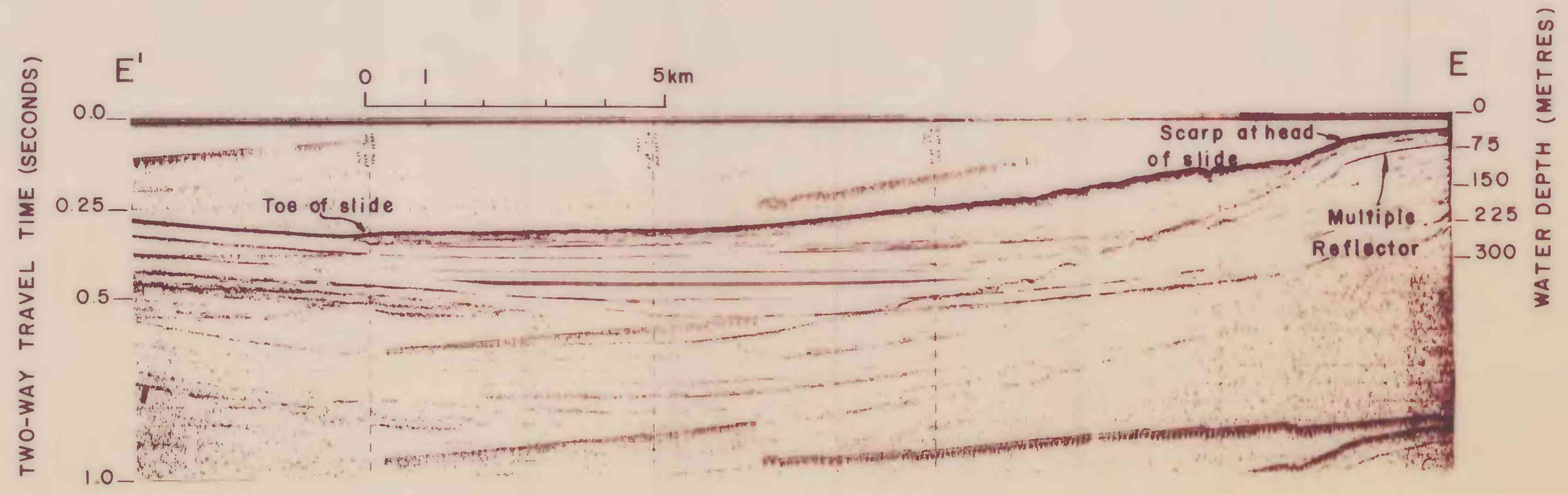
B. Minisparker profile showing older faulted and folded strata (Tertiary-Pleistocene) cropping out at the seafloor. (Vertical Exaggeration (V.E.) = 10X).



C. Minisparker profile south of Cape Yakataga showing older faulted and folded strata (Tertiary-Pleistocene?) overlain by thin blanket of Holocene sediment. (V.E. = 10X).

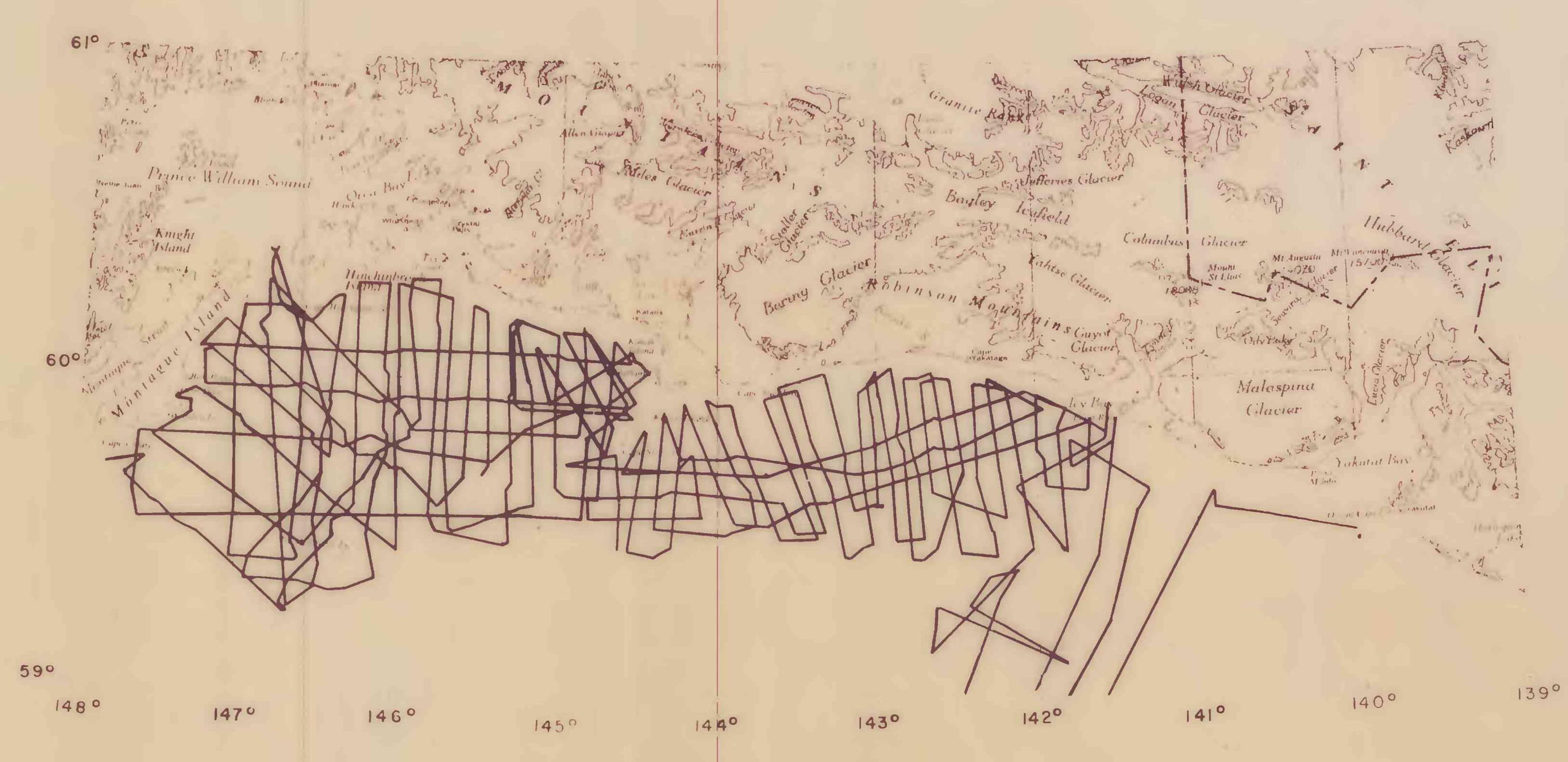


D. Minisparker profile showing slump structures (disrupted reflectors) in Copper River prodelta sediments. (V.E. ≈ 10X)



E. Minisparker profile of massive slide in Holocene sediments south of Katalla. (V.E. = 10X).

This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey standards and nomenclature.



A. Index of seismic reflection lines.

SUBMARINE SLIDES AND NEARSURACE FAULTS, NORTHERN GULF OF ALASKA

By

Paul R. Carlson, Terry R. Bruns and Bruce F. Molnia

1975

U.S. GEOLOGICAL SURVEY
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