ALASKA DIVISION OF GEOLOGICAL &
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PUBLIC-DATA FILE 86- 53p
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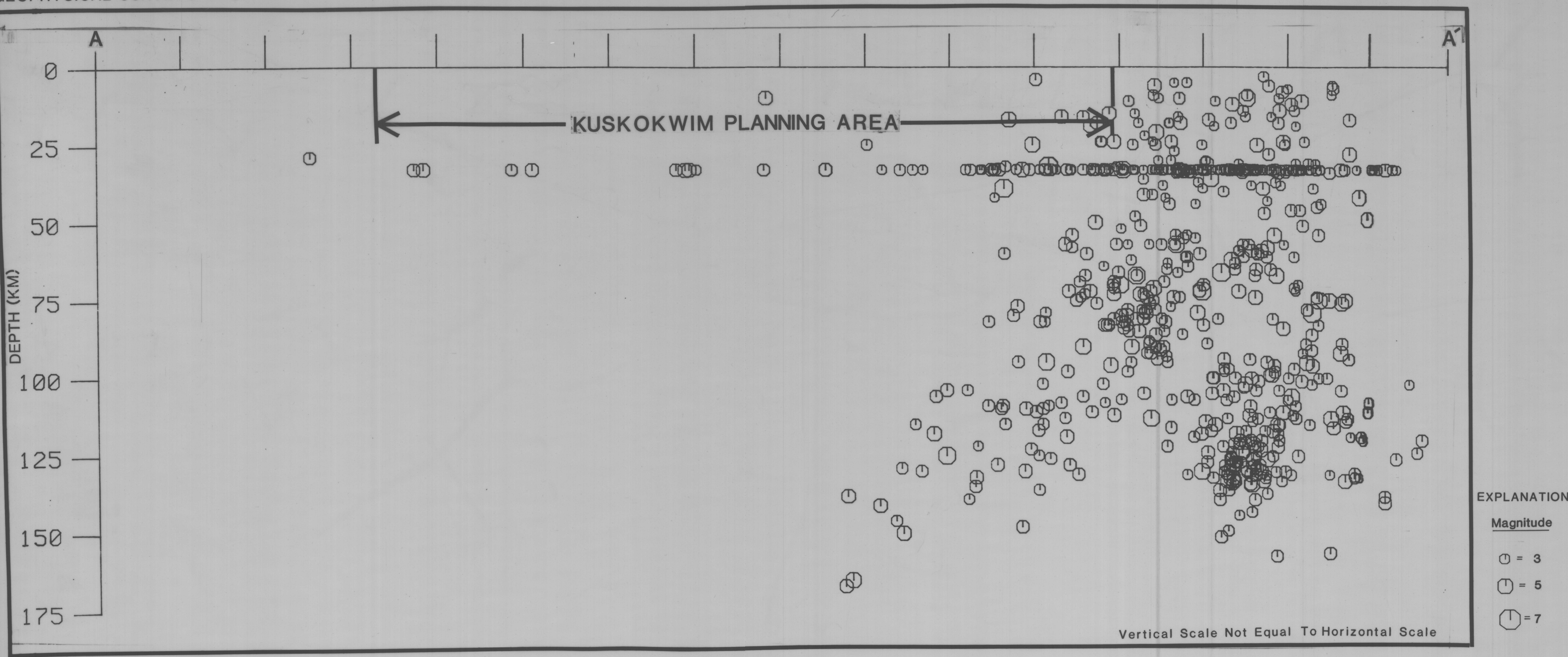
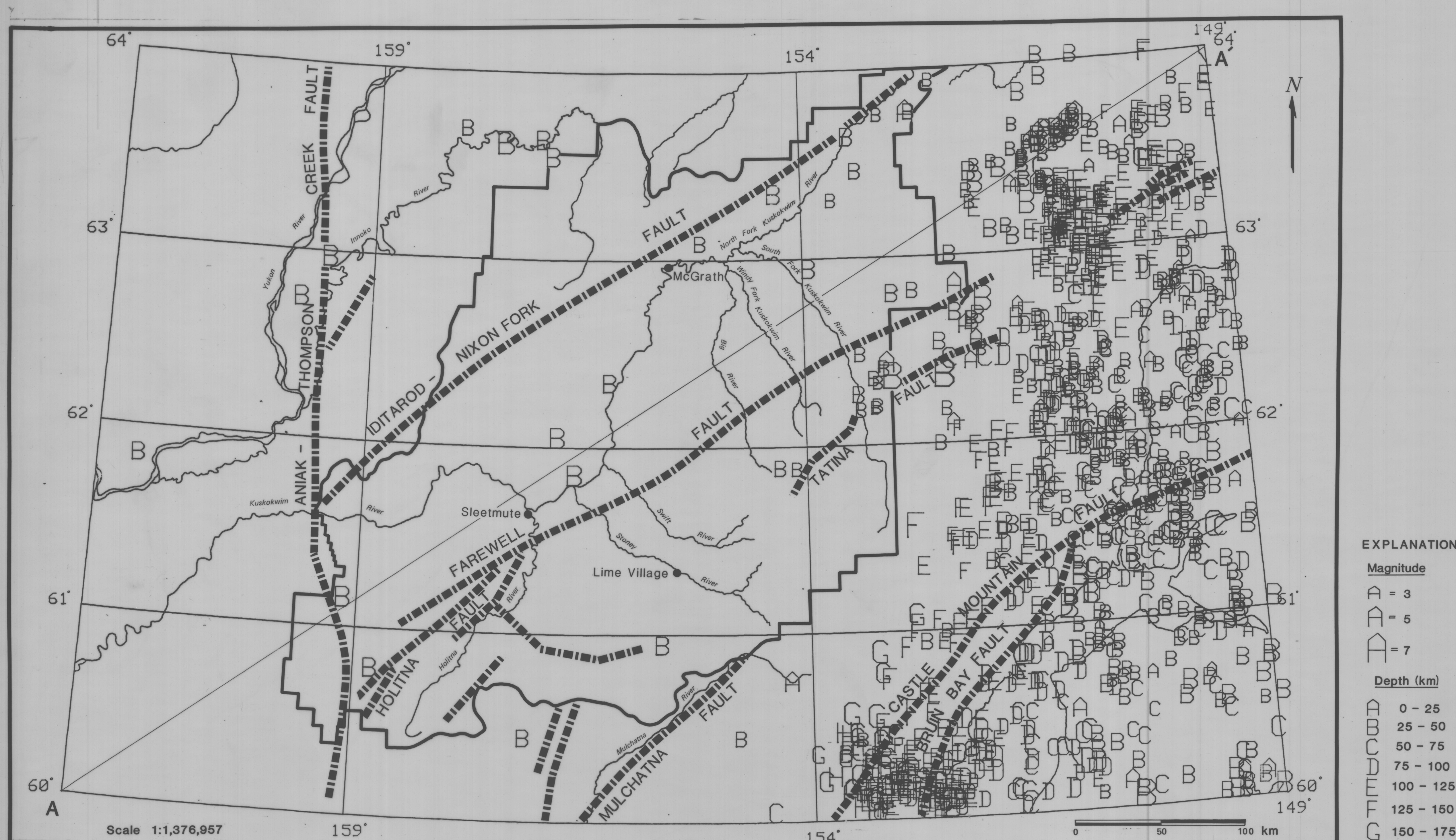


SEISMIC CROSS-SECTION THROUGH THE UPPER KUSKOKWIM RIVER REGION, ALASKA



(Seismic data from 1966–1985)

MAP SHOWING EARTHQUAKE EPICENTERS AND MAJOR FAULT SYSTEMS
IN THE UPPER KUSKOKWIM RIVER REGION, ALASKA

This report is a preliminary publication of DGGS. The author is solely responsible for its content and will appreciate candid comments on the accuracy of the data as well as suggestions to improve the report.

Alaska Department of NATURAL RESOURCES

SEISMICITY OF THE KUSKOKWIM PLANNING AREA, ALASKA

Compiled by D. D. Adams

1986

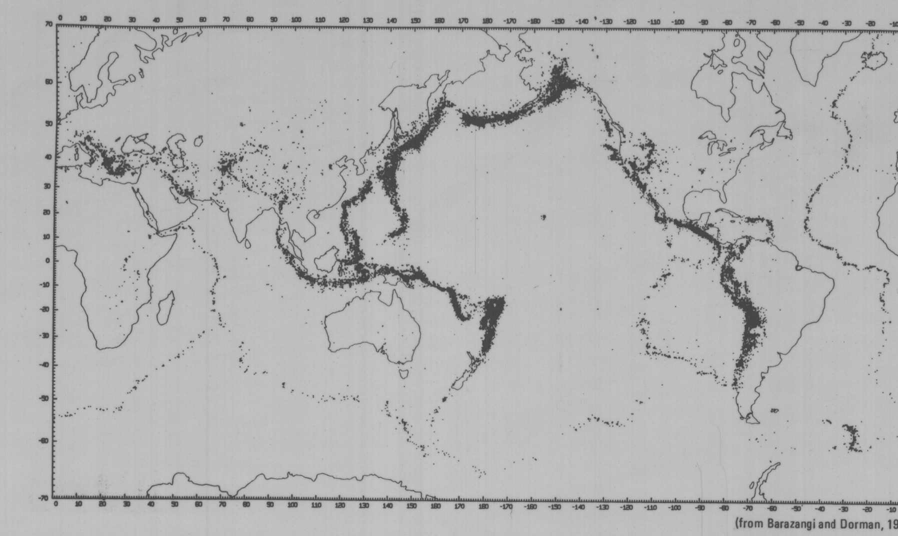


Figure 1. Circum-Pacific Seismic Belt

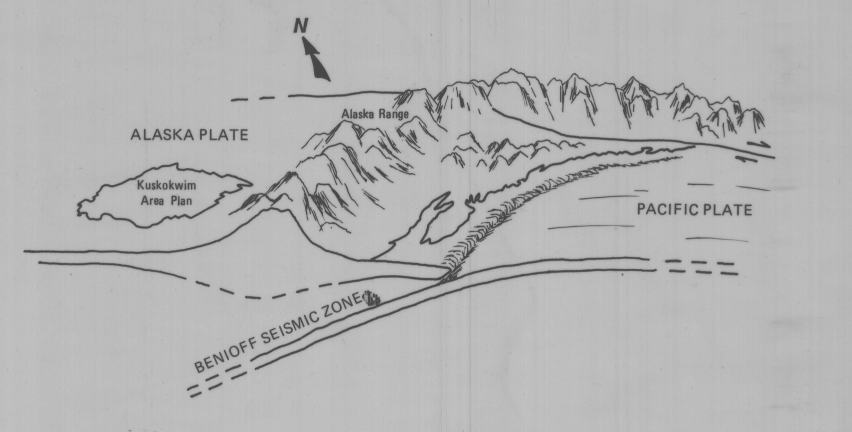


Figure 2. Alaska-Aleutian Subduction Zone

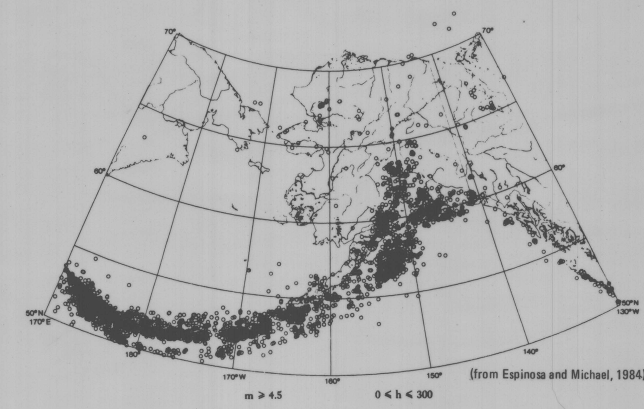


Figure 3. Epicenters of Alaskan Earthquakes of Magnitude 4.5 and Greater

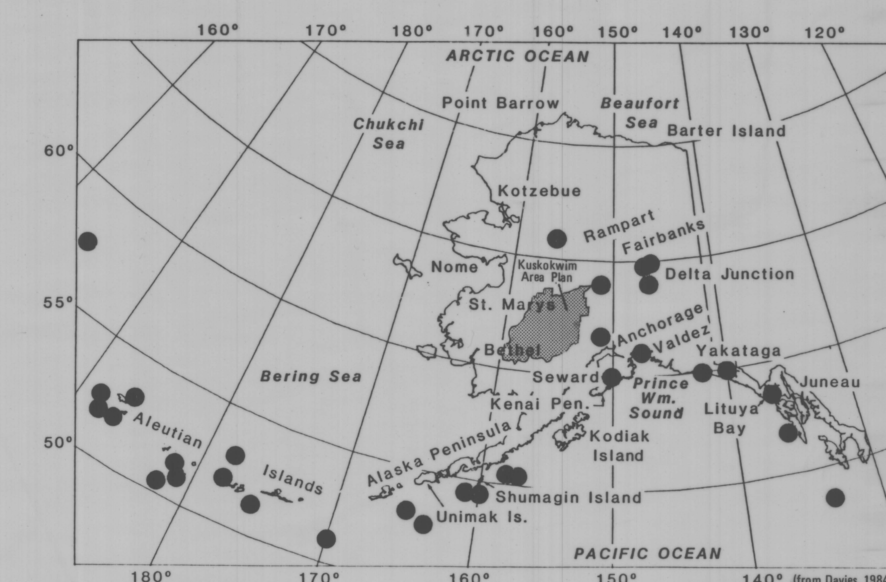


Figure 4. Epicenters of Historic Alaskan Earthquakes of Magnitude 7 or Greater

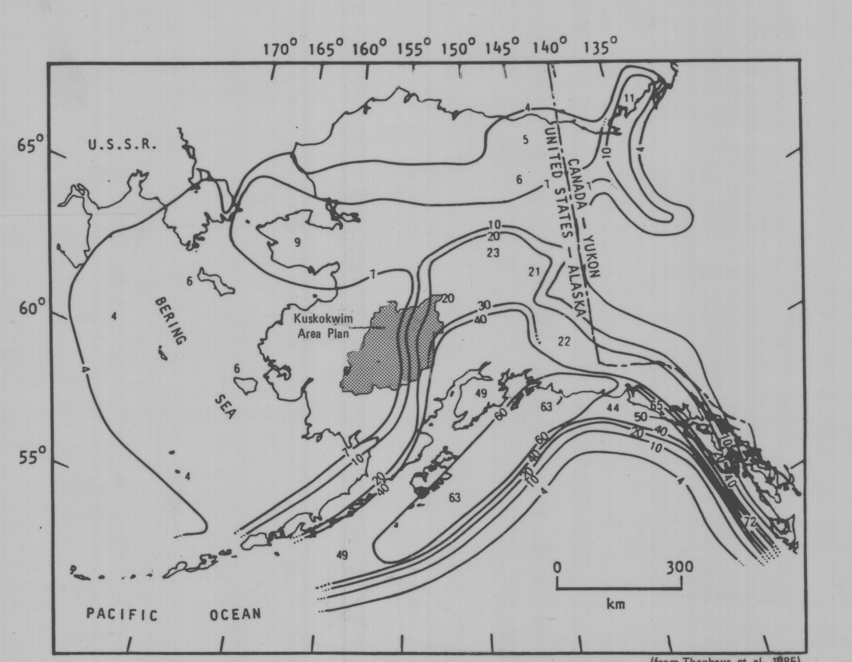


Figure 5. Probabilistic Ground Acceleration Map of Alaska, for the Years 1985–2135 at 10 percent chance of exceedence

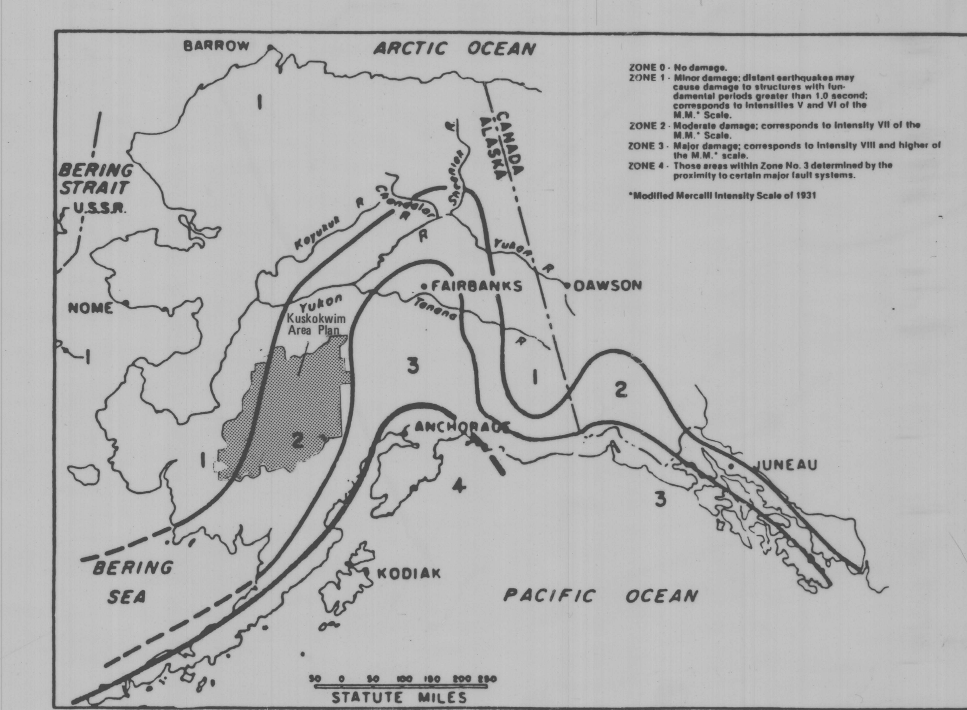


Figure 6. Seismic Zone Map of Alaska

SUMMARY OF SEISMICITY

The upper Kuskokwim River area lies adjacent to and is partly included within the Circum-Pacific seismic belt (figure 1). Seismic activity in this belt is due to the slow movement of adjacent large-scale lithospheric plates which results in either collision, separation or lateral displacement. These movements lead to the accumulation of strain within rocks which form the plates: earthquakes occur when the strain exceeds the strength of the rocks and they suddenly rupture. Seismicity in the Alaskan segment of the Circum-Pacific seismic belt is due to movement of the Pacific Ocean plate relative to Alaska, most of which occurs as northward underthrusting of this plate beneath Alaska at an angle of approximately 45° (figure 2).

Many of the earthquakes in the collision zone of southern Alaska appear to cluster along the upper boundary of the subducting Pacific plate, which is commonly refered to as the Benioff seismic zone. A map plot of earthquakes with magnitudes of 4.5 or greater (figure 3) can be used to help delineate the trend of this zone in Alaska. This seismic zone apparently extends from the Aleutian Islands well into central Alaska. According to the subduction model most of the earthquakes located in the northern portion of the belt, for example those located below the Kuskokwim Planning Area, are fairly deep. No earthquakes of magnitude 7 or greater (which are very destructive when located near populated areas) have been recorded within the area plan (figure 4).

The large-scale map shown left plots the locations of epicenters of earthquakes with magnitudes of 3 or greater which have been recorded in a region of southwest Alaska since 1966 by the U.S.G.S. National Earthquake Information Service. The velocity model of Matumoto and Page (1969) for determining earthquake parameters in the Kenai Penninsula area was utilized in the calculation of these epicenter locations (Pulpan, et, al., 1983). Magnitudes are determined from vertical ground motion although the actual method is based on horizontal ground motion and attenuation properties of Californian earthquakes. Also shown on this map are the major fault zones known to exist in southwest-central Alaska (from Beikman, 1980). Geologic relationships in this region suggest these are 'ancient' faults which have been largely inactive for probably millions of years. This is reenforced by the absence of pronounced clustering of earthquakes along the fault zones. However this evidence does not preclude the possibility of local reactivation along one of these fault zones, especially considering the strain accumulating due to active subduction of the Pacific plate to the south and east. Several small, shallow-level earthquake epicenters appear to be localized along the northeast segment of the Iditarod-Nixon Fork fault and could represent this type of reactivation.

The seismic profile shown above left transects the Kuskokwim Planning area and adjacent region.but actually plots all earthquakes located within the entire epicenter map area. Apparent from the profile is the sparcity of seismicity in the planning area compared to the pronounced seismicity of the nearby Circum-Pacific seismic belt. Also apparent is the westerly-dipping seismic zone which represents the Benioff zone of the subducting Pacific plate. Earthquakes attributed to the Benioff zone would be expected to be quite deep in most of the region underlying the Kuskokwim Planning area, but may be somewhat shallower in the northeast part of this area.

INTERPRETATION OF SEISMICITY

Recurrence intervals of Alaskan earthquakes are used to make future probabalistic estimates of ground motion for different regions of Alaska. An example is given in figure 5 in which values and contours of maximum ground motion (indicated as percent acceleration of gravity) are shown at 90% probability for a 50 year time span (Thenhaus, et. al., 1985). In the western portion of the Kuskokwim Area Plan the values are among the lowest in Alaska. However the eastern portion of the area plan contains values comparable with those seen for Fairbanks or Anchorage. Therefore one might expect larger-magnitude (more destructive) earthquakes in the eastern portion of the planning area. The seismic zone map of Alaska shown in figure 6 is derived from information of this type. The map can be used to recommend materials and structural designs for buildings in different areas of Alaska. Although the zone boundaries are crude the map indicates that structures which are built in most of the Kuskokwim Planning Area should be designed to tolerate earthquakes with intensities of up to
Modified Mercalli Scale (appendix 1).

ACKNOWLEDGEMENTS

Many thanks are extended to John N. Davies and Celia Rohwer of the Alaska D.G.G.S. and University of Alaska-Fairbanks (respectively) for their informative discussions and providing of seismic data computer plots.

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Appendix 1. Modified Mercalli Earthquake Intensity Scale (after Wood and Neumann, 1931).

I. Not felt. Marginal and long-period effects of large earthquakes (for details see text).

II. Felt by persons at rest, on upper floors, or favorably placed.

III. Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.

IV. Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV wooden walls and frame creak.

V. Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.

VI. Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken (visibly, or heard to rustle—CFR).

VII. Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices (also unbraced parapets and architectural ornaments—CFR). Some cracks in masonry C. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.

VIII. Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.

IX. General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. (General damage to foundations—CFR.) Frame structures, if not bolted, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluviated areas sand and mud ejected, earthquake fountains, sand craters.

X. Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.

XI. Rails bent greatly. Underground pipelines completely out of service.

XII. Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.

Masonry A, B, C, D. To avoid ambiguity of language, the quality of masonry, brick or otherwise, is specified by the following lettering (which has no connection with the conventional Class A, B, C construction).

Masonry A. Good workmanship, mortar, and design; reinforced, especially laterally, and bound together by using steel, concrete, etc.; designed to resist lateral forces.

Masonry B. Good workmanship and mortar; reinforced, but not designed in detail to resist lateral forces.

Masonry C. Ordinary workmanship and mortar; no extreme weaknesses like failing to tie in at corners, but neither reinforced nor designed against horizontal forces.

Masonry D. Weak materials, such as adobe; poor mortar; low standards of workmanship; weak horizontally.