

THE COLUMBIA BAY, ALASKA EARTHQUAKES OF JULY 12
AND SEPTEMBER 7, 1983

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In July and September 1983, southern coastal Alaska was shaken by two magnitude 6 earthquakes, the largest shocks in the Prince William Sound region since the great 1964 earthquake. Because of their remote location, the earthquakes caused only minor damage; however, the July shock produced the largest ground accelerations yet recorded from an Alaskan earthquake (see following article).

Both earthquakes occurred at a depth of 30 km in the vicinity of Columbia Bay. The hypocentral coordinates computed from seismic waves recorded by the southern Alaska regional seismograph network are summarized as follows:

Date	July 12	Sept 7
Origin Time	15:10:03.7	19:22:05.0
Latitude	61°02'N	60°59'N
Longitude	147°11'W	147°19'W
Depth	30 km	30 km

The July epicenter was located about 45 km west of Valdez and about 145 km east of Anchorage (Figure 1). The epicenter of the September shock was about 10 km southwest of the July earthquake. The two epicenters lie roughly 25 km east of the epicenter of the 1964 earthquake. The July and September shocks both caused slight damage in Valdez. The Preliminary Determination of Epicenters (PDE) reports of the U.S. Geological Survey (USGS) assign Modified Mercalli intensities of VI to the earthquake effects at Valdez for the two events and intensities of IV and V at Anchorage for the July and September shocks, respectively.

Geologists from the Anchorage Office of the USGS conducted reconnaissance flights over the epicentral region following both earthquakes. There were very few earthquake effects to be seen because of the depths of the earthquakes. Small landslides were observed following the July shock, but not after the September event. Neither earthquake was accompanied by surface faulting.

The magnitudes of the two shocks were comparable. According to the PDE reports, the July earthquake had a body-wave magnitude (m_b) of 6.1 and surface-wave magnitude (M_s) of 6.3. The corresponding magnitudes for the September event were 6.2 and 6.1.

Following each earthquake, the USGS deployed a few portable sensitive seismographs around the epicentral region to delineate the earthquake rupture zone by precisely locating a representative sample of aftershocks. Figure 2 shows hypocenters of aftershocks recorded by both

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the temporary local and permanent regional seismographs during the intervals July 16-24 (30 events) and September 12-14 (25 events). The aftershock hypocenters following the July earthquake (triangles) define a remarkably simple pattern indicating a 26-km long rupture plane, striking northeasterly and dipping at an angle of about 65° to the northwest. The shocks were distributed over the depth interval 22-32 km. The September main shock occurred at the southwestern end of the July rupture and stimulated aftershock activity within a small volume surrounding the main shock hypocenter. The September hypocenters lie within a volume less than 10 km in diameter that coincides at depths shallower than 32 km with the extension of the July rupture plane. The pattern of P wave first motions recorded at regional and distant seismograph stations indicates the two earthquakes were caused by normal, left-lateral oblique slip on the rupture plane defined by the hypocenters in Figure 2.

Based on the depth of the aftershock activity and the type of faulting, we infer that the rupture lies within the upper part of the subducted Pacific plate, which is being thrust beneath southern Alaska. In this tectonic model, the Columbia Bay earthquakes occurred below the gently dipping major thrust boundary between the overriding North American plate and the subducting Pacific plate. Thus, the mechanism of the Columbia Bay earthquakes differs markedly from that of the great 1964 earthquake, which involved slip on the thrust boundary between the plates.

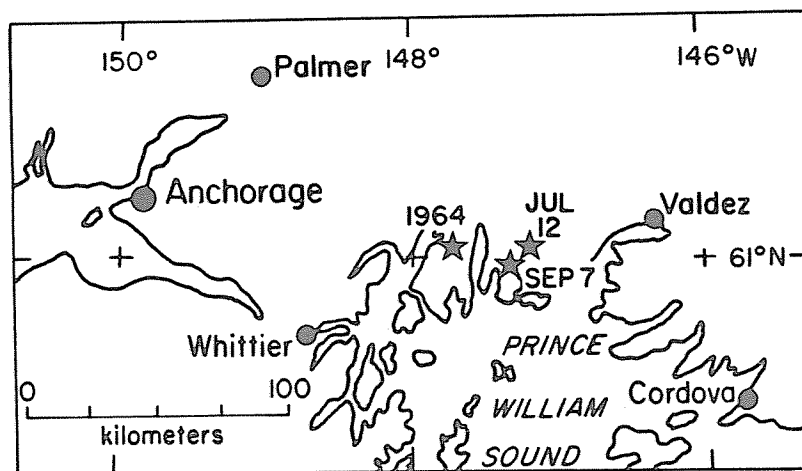


Fig. 1. Map of Prince William Sound region, southern Alaska, showing epicenters (stars) of the July 12 and September 7, 1983, Columbia Bay earthquakes and of the 1964 Prince William Sound earthquake.

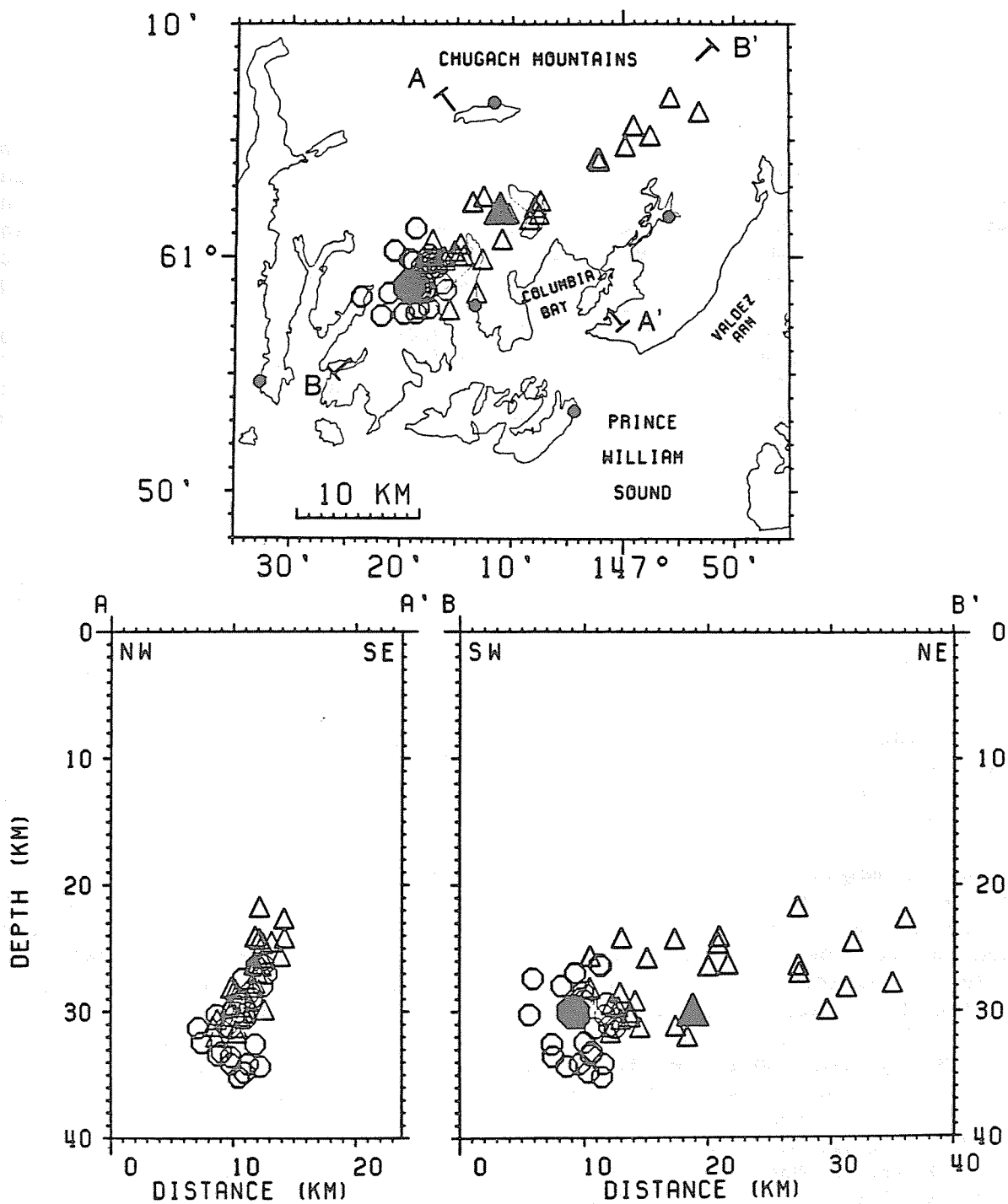


Fig. 2. (Top) Epicenter map of aftershocks (open symbols) of the July 12 and September 7 earthquakes (solid triangle and octagon, respectively). Small solid circles indicate temporary local seismographs. Aftershocks are in the magnitude range 2.0-3.5. End points of vertical sections shown in bottom part of figure are indicated. (Bottom) Vertical cross sections of aftershock hypocenters. Symbols as in map. Left section is view looking to northeast along strike of aftershock zone. Right section is view looking to northwest in dip direction of aftershock zone.