

1999 and 2001 M_w 7 Earthquakes in the Kodiak Region, Alaska

Hansen, Roger A. and Natalia A. Ratchkovski, Geophysical Institute, University of Alaska Fairbanks, Fairbanks, AK 99775-7320; tel. (907)-474-7472; e-mail: natasha@giseis.alaska.edu

Two M_w 7 earthquakes occurred in the Kodiak Island region in a little over a year. The first one occurred on December 6, 1999 and was followed by a M_w 6.4 aftershock a day later. Its epicenter was located between Olga Bay and Karluk Lake. Alaska Earthquake Information Center (AEIC) located over 400 aftershocks of this event throughout the end of December, 1999. The second event occurred on January 10, 2001 and was located offshore. Both earthquakes were felt strongly in the Kodiak communities. In addition, on July 11, 2000, a M_w 6.5 earthquake occurred immediately north of the aftershock zone of the 1999 M_w 7 earthquake.

The 1999 and 2001 M_w 7 events and their aftershocks recorded by the regional seismic network were relocated using the Joint Hypocenter Determination (JHD) method. Regional broadband data were used to calculate moment tensors for the main shocks and their larger aftershocks.

The relocated hypocenter of the 1999 M_w 7 earthquake is positioned at 57.31°N and 154.29°W at 35.8 km depth. The majority of the relocated aftershocks are distributed between 26 and 83 km depth along a steeply dipping plane with a southwest-to-northeast orientation. The moment tensor solution for the main shock indicates a fault plane striking at 29° azimuth and dipping at 66° . The inversion for the M_w 6.4 aftershock resulted in nearly pure dip-slip faulting on a plane striking at 234° azimuth and dipping at 89° . These results are in agreement with the fault plane delineated by the aftershock locations and with the teleseismic and regional P-wave first motions.

Location of the 2001 M_w 7 earthquake has not changed significantly with respect to the AEIC location after the relocation. It remained at 30 km depth. Relocated aftershocks are concentrated between 20 and 50 km depth. We calculated moment tensor solutions for the main shock and three M_L 4+ aftershocks using regional broadband data. Faulting parameters of the aftershocks are similar to each other and to the main shock. The first focal plane has a shallow dip angle (between 4° and 14°) and aligned in SSE-NNW direction. The second plane is nearly vertical and aligned in southwest-northeast direction, i.e parallel to the trench.

Convergence of the Pacific and North American plates dominates the tectonic framework of the Kodiak region. The plate boundary lies along the Aleutian trench about 100 km seaward of Kodiak Island. The aftershock relocation and moment tensor inversion results indicate that both the 1999 and 2001 M_w 7 earthquakes in the Kodiak Island region were located within the subducting Pacific plate. Their fault planes are parallel to the strike direction of the subducting plate and cut across the plate through its significant portion. These earthquakes are the first well documented large intraplate events in the Alaska-Aleutian subduction zone.