

The 3 November 2002 M7.9 Denali fault, Alaska earthquake: double difference relocation of aftershocks

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The M7.9 Denali Fault earthquake occurred at approximately 1:12 PM AST on 3 November 2002 and ruptured approximately 300 km of the Denali fault, a major right lateral strike-slip feature in central Alaska. This event is the largest earthquake recorded on the Denali Fault System (DFS). The Denali Fault earthquake was preceded by the 23 October 2002 M6.7 Nenana Mountain earthquake that ruptured a segment of the Denali fault approximately 20 km west of the Denali Fault earthquake epicenter.

Denali Fault earthquake began as a thrust event on the Susitna Glacier thrust fault, a southward trending splay of the Denali fault. Rupture then transferred to the Denali fault and propagated 220 km eastward. At this point, rupture left the Denali fault and propagated 55 km along the southeast trending Totchunda fault. Along most of the rupture length, surface breaks were visible allowing geologists to measure a maximum offset of 8.8 meters.

The Alaska Earthquake Information Center began the deployment of a temporary network of broadband and strong motion seismometers following the Nenana Mountain event to supplement the 350 existing stations of the Alaska Seismic Network in recording aftershocks. This network was distributed along the Alaska, Glenn, Richardson and Denali highways as well as several along the Nebesna Road. Six of these instruments were installed prior to the M7.9 event and 20 more in the week following. In the first month following the Denali Fault earthquake over 8,000 aftershocks were recorded.

Here we present the locations of aftershocks for the Nenana Mountain and Denali Fault events. The earthquakes were initially located by AEIC analysts, then relocated using the double difference method. The distribution of aftershocks indicates complex faulting along the rupture zone. In the vicinity of the M7.9 epicenter, the distribution of aftershocks is bounded to the south by the Susitna Glacier fault but is not constrained by the Denali fault to the north. Focal mechanisms of many aftershocks north of the Denali fault have a thrust component. This could indicate that a series of small thrusts north of the Denali fault were activated by the earthquake. Additionally, seismicity is observed on McGinnis Glacier and McCallum-Slate Creek faults following the M7.9 event, suggesting that rupture on these faults was initiated by the Denali Fault earthquake. From these observations it is evident that the Denali Fault earthquake activated a significant portion of the DFS. We are currently in the process of generating highly accurate cross-correlation derived relative locations for these aftershocks, in the hope that a clearer picture of seismicity will result.