Crustal heterogeneity in the source area of the 2002 Denali fault earthquake in central Alaska

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Alaska is one of the active subduction regions where intense seismicity including many large earthquakes occur. Recently a very large crustal earthquake, the Denali fault earthquake (Mw 7.9), occurred on October 3, 2002, in central Alaska.

In this study, we investigated the 3-D seismic structure of the Denali earthquake source areas to understand the role of crustal heterogeneity on the genesis of the mainshock and aftershock sequence. We applied a seismic tomography method (Zhao et al., 1992) to 72,000 P and 20,000 S wave arrival time data from 1500 earthquakes recorded by the Alaska Earthquake Information Center (AEIC).

Our results are as follows. (1) The mainshock is located in a distinct zone which is characterized by high P and S wave velocity anomalies. Most of the aftershocks are located in the high P wave velocity area. (2) High velocity anomalies near the mainshock source zone may represent a more brittle and competent part of the fault (asperity) in the upper crust. (3) The feature of high-velocity anomalies near the mainshock hypocenter is similar to the velocity structure at the mainshock zones of the 1994 Northridge earthquake and the Landers earthquake. (4) Low-P wave velocity anomalies are visible under the volcanoes in the eastern part of the study area, which may reflect magma chambers under the volcanoes.