Searching for precursory events prior to large earthquakes
2002 Denali Fault

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Recent work by Bouchon et al. [Science, 331, 877 (2011)] has shown that the 1999 Izmit, Turkey earthquake was preceded by a remarkable sequence of much smaller earthquakes that demonstrate a tractable relationship to the M_w 7.6 mainshock. The rate of these events accelerated prior to the mainshock and they have a repeating waveform indicating a fixed source and fault mechanism. The multiplet aspect of these earthquakes is an instructive observation but also suggests a mechanism for identifying such sequences even when they elude obvious visual detection.

Spurred by the Izmit sequence, we revisited the 2002 M_w 7.9 Denali Fault Earthquake to establish whether or not similar precursory microearthquakes might have occurred. We use a cross-correlation technique to examine a 22-hour window prior to the earthquake to look for *any* signal in the record that could be identified multiple times. We scan for matching waveforms on all channels (filtered 3-20 Hz) within 100 km of the hypocenter. We also include two hours of the aftershock sequence as it provides a control dataset to validate our approach.

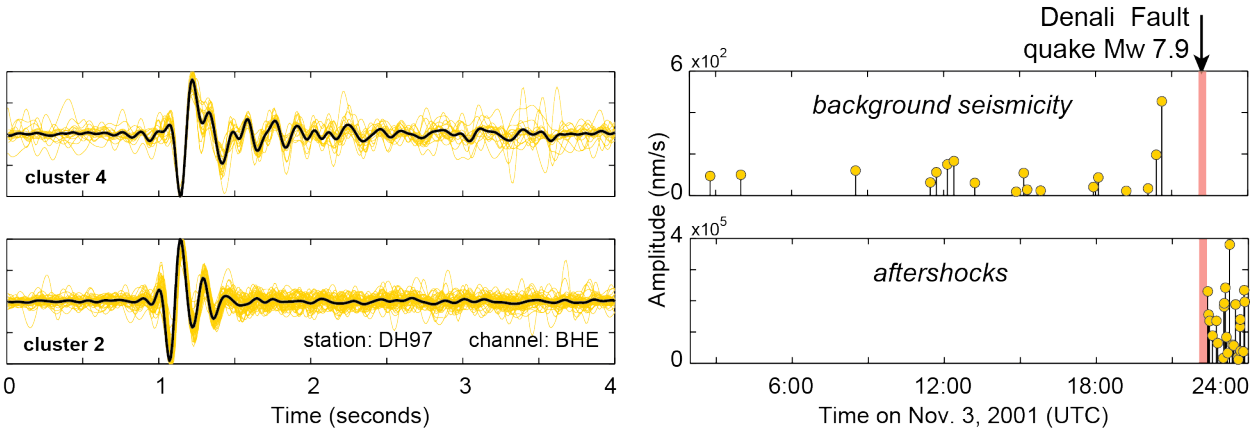

Figure. *Repeatedly observed micro-earthquakes and their time-amplitude patterns surrounding the Mw 7.9 Denali Fault Earthquake. The event family on the top is typical of background seismicity. Low amplitude events with this type of on-going time pattern are present on most stations. While they likely reflect minor local tectonics, they show no time association with the Denali Fault Earthquake. Such events are observed on most stations. The waveform on the bottom is one of the countless aftershock event families. Though larger in amplitude and clustered in time, these events do not occur until after the main shock. No comparable families are found prior to the Denali Fault Earthquake.*

We find no repeating micro-earthquake activity prior to the Denali Fault earthquake. If such seismicity occurred, it is below the noise floor of existing data. There are several tectonic reasons why this event may not have generated such seismicity. It is also possible that such activity was simply too small to be recorded. While capturing such events requires a degree of serendipity, Alaska's high rate of large earthquakes provides an ideal environment. The Transportable Array would greatly improve the odds of acquiring rare proximal datasets by ensuring a base level of coverage across a vast area. This objective is unlikely to warrant a dedicated Flexible Array deployment. However, the Flexible Array stations are likely to be deployed in higher seismicity regions, making the possibility of a dense near-source nucleation dataset all the more likely.