

# **Volcanic hybrid earthquakes observed at Mount St. Helens: does seismological evidence point to brittle-failure as a mechanism for dome building?**

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## **ABSTRACT**

Volcanoes generate a variety of pre-eruptive low-frequency seismic signals. Hybrid earthquakes comprise a class of these signals having high-frequency onsets followed by low-frequency ringing. They are used empirically to predict eruptions, but their ambiguous physical origin limits their diagnostic use. The short-duration, near-field hybrid seismograms associated with the 2004 Mount St. Helens eruption indicate that much of the prolonged signal is due to path rather than resonating fluids. We show using seismic source spectra that the hybrids have a corner frequency/seismic moment relationship that scales consistently with brittle-failure. The unusually low frequency of these earthquakes can result from low rupture velocities combined with strong path effects due to their shallow sources. This new application of near-field instrumentation provides the first seismological evidence for brittle-failure as a major process in dome building, and suggests that hybrids should not be used as direct indicators of fluids.