

# **Megathrust-zone heterogeneity and megathrust earthquakes**

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To clarify the causal mechanism of megathrust earthquakes, we studied 3-D P- and S-wave velocity (V) and attenuation (Q) structures of the Tohoku and Nankai subduction zones using a large number of arrival-time and  $t^*$  data measured precisely from seismograms of local earthquakes. The suboceanic earthquakes used for tomographic imaging are relocated precisely using sP depth-phase and OBS data. Our results show the existence of significant structural heterogeneities in the megathrust zones. Megathrust earthquakes during 1900 to 2013 nucleated in or around the high-V and high-Q patches which may represent strongly coupled areas (i.e., asperities) in the megathrust zone. Our results indicate that structural heterogeneities in the megathrust zone, such as the subducting seafloor topography and compositional variations, control the nucleation of the megathrust earthquakes.