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- About
- Meetings
- Sections
- Index Terms
- Advanced Search

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Interrogating Cascadia in Nankai (and Vice Versa)

Details

Meeting	2008 Fall Meeting
Section	Tectonophysics
Session	Plate Boundary Processes in the Nankai Trough Subduction Zone III
Identifier	T22B-01
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Abstract

In global subduction-zone "thermometry", Cascadia and Nankai are both warm-slab end members and share a sharp contrast with cold-slab subduction zones. A direct consequence of the warmth of the young subducting slab is its shallow dehydration. The absence of intraslab earthquakes below 80-90 km depths in Cascadia and Nankai is understood to be related to the shallow dehydration of the slab. The slab releases most of its aqueous fluids before reaching the volcanic front where mantle temperature is high enough to cause melting of H_2O-rich peridotite. The scarcity of fluids beneath the arc results in feeble volcanism (more so in Nankai), but the abundance of fluids in the forearc facilitates serpentinization of the mantle wedge. A high degree of mantle wedge serpentinization and the availability of free fluid may be responsible for the occurrence of episodic non-volcanic tremor around the wedge tip with accompanying slow slip of the subduction interface (the ETS events). The warmth of the slab also causes the megathrust seismogenic zone to be located shallower than in cold-slab subduction zones. In addition to these fundamental similarities associated with warm slabs, Cascadia and Nankai also have many "fortuitous" similarities due to regional tectonics and geology, such as the development of a large accretionary prism, the presence of a splay fault that potentially contributes to tsunami generation, the margin-parallel direction of compressive stress in the continental forearc, and the margin-normal direction of interseismic shortening. We have learned from the similarities between the two subduction zones, and we are beginning to learn from their differences. For example, great earthquakes at Cascadia tend to rupture very large distances along strike and have long recurrence intervals (~500 yrs; though with ~250 yr intervals along the southern margin), as suggested by offshore paleoseismic evidence, but those at Nankai tend to have shorter rupture lengths and recurrence intervals (~100 yrs). The reason may be that the plate interface at Cascadia is much smoother than at Nankai where the subducting plate carries many seamounts and suffers severe deformation during subduction. At Nankai, there are numerous very-low-frequency earthquakes in the shallow outer wedge offshore and in the deep ETS region. A preliminary search for these events at northern Cascadia using available seismic data indicates that similar events may also be present at Cascadia but by no means as abundant as at Nankai. The difference may be related to their different lapse times since the previous great earthquake and states of stress relaxation: A great earthquake occurred only a few decades ago at Nankai but over three centuries ago at Cascadia. One obvious difference surely caused by the different lapse times is the geodetically constrained interseismic elastic strain rate in the forearc: The rate is much higher at Nankai than at Cascadia. Some differences between the two subduction zones are yet to be investigated. For example, many earthquakes have been detected in the trench area at Nankai, but there is an apparent seismic quiescence in the same area at Cascadia. A plan is being developed to investigate the apparent quiescence at Cascadia using ocean bottom seismographs.

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