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Reconstruction of recent ~10Ma thermal structure seaward of updip limit of Nankai seismogenic zone off Kumano inferred from IODP NanTroSEIZE geothermal data and time-dependent numerical model

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Understanding the slip behavior of the seismogenic faults in subduction zones requires accurate estimates on the present & past thermal structures. Some geochemical processes that affect the effective fault strength (such as clay mineral dehydration) require a knowledge on the thermal history of sediment particles since its deposition.
To depict the thermal history, we need to know the tectonics and thermal regime of the Philippine Sea plate (PHS), which may have stopped subduction until ~6MaBP, and restarted afterwards. Our purpose here is to test if such subduction tectonics can affect the 'present' thermal regime, which can be constrained by the heat flow measured at the seafloor or by the borehole measurements.
During the IODP NanTroSEIZE expeditions, we deployed 2 borehole observatories containing 5 thermistors. In 2012, the first observatory was deployed at Site C0002 above the updip limit of locked portion of megathrust, and the temperature and heat flow at ~900 m below seafloor is determined as 37.8 degC and 57 mW/m2, respectively (Sugihara et al., 2014). In 2016, we deployed the second observatory at Sites C0010 across the shallow portion of megasplay fault zone. Thermistors are located between ~400 mbsf (crossing the fault zone) and 562.72 mbsf, and the temperature at 562.7 mbsf is 26.7 degC. With core thermal conductivity data, average heat flow is determined as ~60 mW/m2. It is slightly higher than the heat flow at the nearby Site C0004 (54 mW/m2; Harris et al., 2011). This high heat flow may be attributed wither to pore fluid flow or transient phenomena (e.g., burial due to thrust faulting).
Using these heat flow data, a thermal structure model around the updip zone of Nankai seismogenic zone is constructed for 2 end-member models; subduction of 12Ma-old Shikoku Basin (SB) started at 6MaBP, vs. subduction of 5Ma-old SB continued since 13MaBP. To account for the high heat flow seaward of trough axis, we followed the effective thermal conductivity model (Spinelli et al., 2011) simulating the permeable layer on top of subducted oceanic crust.
We found that two end-member models (subduction has been continuous vs. it started 6MaBP) are very similar and impossible to discriminate to each other. We also found that the thermal structure at 6-3MyBP can be different from the present one. In that case the accretionary prism evolution, as reconstructed through paleo-thermometry, may need reconsideration.