Stratigraphic and geothermal regime seaward of Nankai Trough off Kumano inferred from piston-core samples and heat flow data

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Recent studies on seismogenesis revealed that a magnitude of earthquakes is largely dependent on the size of asperity, or locked region, along the subducting plate boundary.. The subducting oceanic crust and overriding sediment change their elastic and frictional properties as they are buried, heated, dehydrated and altered. What are input in what thermal condition from the seaward of Nankai Trough is therefore one of the keys for understanding the nature of asperity. IODP NanTroSEIZE project will address this problem, and will drill two sites in the incoming Philippine Sea Plate

The KY07-01 cruise was carried out in this area in Jan. 2007, using R/V KAIYO of JAMSTEC. During this cruise 12 piston core sampling and heat flow measurements were simultaneously made along the MCS line KR9806-02 (IFREE-JAMSTEC crustal structural database). IODP NanTroSEIZE drillsites are approximately aligned along this line.

Our survey area is classified into 4 categories; the trough floor between the deformation front and deepsea channel, northern slope of the Kashinozaki-Knoll and its southern foot, and the Shikoku Basin to the south.

Shikoku Basin sediment at PC-04 consists of ~1m-thick hemipelagic sediment underlain by ~10-cm thick ash layer. Heat flow is ~135 mW/m2, significantly higher than the theortical value (110 mW/m2) estimated from the age of Shikoku Basin (20 Ma). It may be because of past hydrothermal activities in the Shikoku Basin, or possible off-ridge volcanism, although we do not see basement high in this region.

Bathymetry suggests at least 6 submarine slides occurred around the Kashinozaki Knoll. On the southern foot of the knoll, yellowish silty clay with pumice fragment indicating debris flow was sampled below hemipelagic sediments at PC-08 (2.2m). Heat flow is ~145 mW/m2, the highest in this region.

Two samples were taken on the northern slope of Kashinozaki Knoll, PC-07 (1.3m) at the same location of NanTroSEIZE drillsite NT1-7, and PC-09 (0.4m) 2 miles from PC-07. Both sites are dominant with yellowish silty clay with pumice fragment,which looks similar to PC-08 sample. Heat flow was identical on both sites, ~110 mW/m2.

Two samples were taken ~1 mile seaward of the deformation front (1.7m at PC-10 and 2m at PC-12). At both sites series of turbidite were identified beneath the hemipelagic mud. However, heat flow is lower (~90 mW/m2) at PC-10 than at PC-12 (~135 mW/m2).

Rapid sedimentation of turbidite (~1mm/year) can apparently reduces surface heat flow by up to ~15 %. Slumping can reset the surface temperature, resulting in zero heat flow at surface. All the coring sites in this study are more or less in depositional condition, thus the heat flow from the oceanic crust would be higher than those observed at seafloor. The heat flow from the oceanic crust can be as high as 130 to 150 mW/m2, instead of currently accepted value of 100-110 mW/m2.

Although this high heat flow anomaly may be caused by a local off-ridge volcanism, it can still substantially affect the the thermal structure of subducted material and therefore the frictional behavior of the fault.