Heat flow distribution along the Nankai Trough floor: Correlation with the structure of the incoming oceanic crust

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Surface heat flow observed on the floor of the Nankai Trough should reflect the thermal structure of the incoming Philippine Sea plate (Shikoku Basin). Detailed measurements along the trough axis revealed that heat flow on the trough floor in the central part (between 135˚E and 136˚E) is extremely high and variable, much higher than the value corresponding to the seafloor age. On the east of 136˚E, heat flow steeply decreases eastward to the value consistent with the age with no appreciable scatter. In the area west of 134.5˚E, the observed heat flow is more or less normal for the age and shows low scatter. This peculiar heat flow distribution is well correlated with the structure of the Shikoku Basin oceanic crust. The high and variable heat flow area in the central part corresponds to the youngest part of the Shikoku Basin, which was formed by spreading in the NE-SW direction, whereas the neighboring areas with less scattered and lower heat flow were formed by E-W spreading. Other geophysical data, e.g., seismicity, crustal thickness, and basement topography, also show significant variations around the boundaries between the two spreading directions, indicating that the crustal structure changes across the boundaries. The high heat flow in the central part can be attributed to vigorous fluid circulation in a permeable layer (aquifer) in the subducted oceanic crust, which efficiently transports heat upward along the plate interface (Spinelli and Wang, 2008). It is probable that the permeability structure of the oceanic crust changes at the boundaries between the E-W and NE-SW spreading, which yields variations in vigor and/or pattern of fluid circulation, resulting in the observed high to normal heat flow transitions across the boundaries. Another feature of the heat flow distribution in the central part, high variability, appears to arise from the crustal structure as well. The central part is characterized by large basement relief and heat flow values have negative correlation with sediment thickness; heat flow tends to be high on basement highs. Similar correlation cannot be recognized in the areas formed by E-W spreading. It suggests that the high heat flow variability in the central part may also be due to fluid circulation in the permeable layer. These results indicate that the structure of the Shikoku Basin originated from its spreading history has a large influence on physical/chemical conditions along the plate interface (seismogenic zone of large thrust earthquakes and slow erathquakes) through fluid and heat transportation in the oceanic crust.

Keywords: Nankai Trough, Shikoku Basin, heat flow, oceanic crust, fluid circulation, basement topography

