論 文 の 内 容 の 要 旨

論 文 題 目　Study on shallow thermal regime examined by methane hydrate bottom-simulating reflectors and distribution of shallow slow earthquakes in the Nankai Trough
（メタンハイドレートBSRから推定される南海トラフ浅部温度場と浅部スロー地震の分布に関する研究）

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Temperature below the seafloor is an important property, influencing not only depths of methane hydrate development but also the aseismic-seismic transition along the megathrust in the plate subduction margin. This thesis aims at investigating temperature at the plate interface shallower than approximately 10 km below seafloor in the wide range of the Nankai Trough utilizing characteristics of methane hydrate bottom-simulating reflectors (BSRs) in reflection seismic images. The Nankai Trough is formed by the subduction of the Philippine Sea plate beneath the Eurasian plate, where earthquakes of magnitude 8 have repeatedly occurred. The occurrence region of megathrust earthquakes is considered to be controlled by subseafloor temperature. In addition, deep slow earthquakes that occur at the deeper portion of the thermally defined seismogenic zone are also suggested to be affected by temperature off Tokai. However, there are few studies that evaluate relationship between temperature and shallow slow earthquakes that occur at the shallower portion of seismogenic zone, partly because the shallow subseafloor thermal structure has not been well determined.

In Chapter 2, I first investigate distribution of BSRs from offshore Tokai to Hyuga in the Nankai margin using 142 reflection seismic profiles. The presence of BSRs was confirmed from forearc basins to the accretionary prism slope in the Nankai margin. I confirmed for the first time the presence of BSRs at the prism toe and the trough floor offshore Tokai region. Second, I estimate heat flow from BSRs and apply the bathymetric correction to heat flow in the undulating seafloor of the prism slope. Although BSR-derived heat flow varies in convex or concave seafloor regions compared to the less undulating areas, topographically corrected BSR-derived heat flow fits well with the heat flow at surrounding areas. This result indicates that bathymetry significantly affects BSR-derived heat flow.

In Chapter 3, I estimate temperature at the plate interface in the Nankai margin using BSR-derived heat flow including topographically corrected values, as presented in Chapter 2, and borehole-derived heat flow. As a result of the temperature estimation, the plate interface temperature off Muroto is found to be low at approximately 150 km in width compared to other areas such as off Tokai and Ashizuri. This low-temperature region implies existence of vigorous hydrothermal circulation within the subducting oceanic crust. Second, I compare temperature with occurrence region of shallow slow earthquakes such as very low frequency earthquakes and low frequency tremor off Kii Peninsula and Hyuga. I find that upper limit of the occurrence of shallow slow earthquakes is at approximately 50°C in these areas, implying that the seismogenesis of shallow slow earthquakes is likely affected by temperature. Therefore, I hypothesize that dewatering caused by mineral dehydration that becomes significant in this temperature range enhances pore pressure that may result in inducing shallow slow earthquakes.

In Chapter 4, I first discuss similarities and differences of BSR distribution between the Nankai margin and other convergent plate boundaries briefly reviewed in Chapter 1.

Second, I evaluate sedimentation effect on heat flow estimation at the prism slope, where the plate interface temperature is estimated in Chapter 3. Finally, I discuss effect of bathymetric correction in estimating the plate interface temperature. Specifically, I find the difference of the plate interface temperature calculated from topographically-uncorrected and corrected BSR-derived heat flow has locally up to 8°C.

Major findings are revealing possibility of shallow slow earthquakes being affected by temperature and the width of vigorous hydrothermal circulation within the oceanic crust off Muroto, in light of wide subseafloor temperature estimation by means of first-ever detailed BSR mapping. Another finding is revealing the presence of BSRs at the prism toe and the trough floor off Tokai. All the results provided in this thesis represent an increase in our understanding of thermal structure and occurrence regions of shallow slow earthquakes in the Nankai margin.