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Roles of Hydrothermal Circulations on Heat Flow in the Fore-arc, Northeast Japan Subduction Zone, A Numerical Modeling Study.

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Heat flow in the fore-arc, Northeast Japan shows characteristic highs and lows in the seaward and landward regions of the trench axis, respectively, compared to 50 mW/m^2 that is constrained from the corresponding half-space cooling model (135 Ma). For example, the high average of 70 mW/m^2 at the 150-km seaward region from the trench was observed while the low average of 30 mW/m^2 at the 50-km landward region was. To explain the differences between the constraints and observations of the heat flow, previous studies suggested that the high heat flow in the seaward region results from the reactivated hydrothermal circulations in the oceanic crust of the Pacific plate along the developed fractures by the flexural bending prior to subduction. The low heat flow is thought to result from thermal blanket effect of the accretionary prism that overlies the cooled subducting slab by the hydrothermal circulations. To understand heat transfer in the landward region of the trench, a series of two-dimensional numerical models are constructed by considering hydrothermal circulations in the kinematically thickening accretionary prism that overlies the converging oceanic crust of the Pacific plate where hydrothermal circulations developed prior to subduction. The model calculations demonstrate no meaningful hydrothermal circulations when the reasonable bulk permeability of the accretionary prism ($<10^{-14} \text{ m}^2$) is used; the thermal blanket effect significantly hinders the heat transfer, yielding only the heat flow of 10 mW/m^2 in the landward region, much lower than the average of 30 mW/m^2 . This indicates that other mechanisms such as the expelled pore fluid by compaction of the accretionary prism play important roles in the heat transfer across the accretionary prism.