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プレート境界上の低粘性層による沈み込み帯3次元温度構造の発達
Development of a 3D thermal structure in the subduction zone due to a low viscosity layer at the plate interface

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It is essential to understand the detailed 3D thermal structure in the subduction zone to better constrain the transport of fluid and melt there. In this presentation, I will propose a simple and new mechanism to produce the along-arc variation in the thermal structure. In the northeast Japan, the earthquakes at the plate interface may occur down to 50 km depth. On the other hand, the slab and mantle may need to decouple down to 80 km depth in this region to explain the observed low surface heatflow in the forearc. These observations may show that the slab and mantle are decoupled by non-brittle deformation from 50 down to 80 km depth. Based on this idea, I set a thin low viscosity layer (LVL) just above the subducting slab within the depth range.

3D finite element models are used to investigate the effects of LVL on the thermal structure. The model domain is divided into four parts: the crust, a small portion of the mantle wedge tip which is rigid, the viscous mantle wedge, and the subducting slab. The model is exactly the same in the along-arc direction. The flow is computed only in the viscous mantle wedge, whereas temperature is computed for the whole model domain. When the viscosity in LVL is relatively high, the slab and mantle are effectively decoupled but there is no along-arc variation in the flow and thermal structure. I find, however, that when the viscosity in LVL is sufficiently low the corner flow starts to show 3D features and it leads to the along-arc temperature variation. It is well known that the distribution of Quaternary volcanoes in the northeast Japan forms clusters whose characteristic wavelength is around 80 km. The model proposed here successfully explains the observed wavelength based on an assumption which is simpler and better constrained by observations compared to previous models.

A previous study has proposed that slab and mantle are decoupled down to a common depth (70-80 km) for most subduction zones. It means that the LVL considered in this study could exist for other subduction zones as well. Therefore, the new model proposed here can be applied to a wide range of regions.

Keywords: subduction zone, plate interface, low viscosity layer, distribution of volcanoes, slab-mantle coupling