Thermal structure of the Tohoku subduction zone predicted by plate cooling models with temperature- and lithology-dependent thermal properties

*Manabu Morishige[1]

1. Earthquake Research Institute, the University of Tokyo

It is critical to better understand the thermal structure of subduction zones because it controls the occurrence of various types of earthquakes (e.g., megathrust, slow, and intraslab earthquakes) and magma genesis. In this presentation, I report the thermal structure of the Tohoku subduction zone predicted by plate cooling models with temperature- and lithology-dependent thermal properties. This study differs from previous studies in that (1) the thermal boundary condition at the trench is determined by the plate model so that it is consistent with the observed changes in surface heat flow and seafloor depth with time, and (2) the Metropolis algorithm, which is a Markov chain Monte Carlo method, is used as the sampling method, which allows us to fully explore the uncertainties in both model parameters and predicted thermal structure. The investigated model parameters are the mantle potential temperature, oceanic plate thickness, thermal conductivity, specific heat, and the coefficient of thermal expansion.
It was found that the obtained oceanic plate thickness is around 95±20 km, whereas the mantle potential temperature is not tightly constrained. The depth uncertainty in the isotherms of the oceanic plate increases with depth and plate age, and reaches around ±10 km and ±20 km for the 600℃ and 1200℃ isotherms, respectively. It leads to the uncertainty in the predicted location of the serpentinite-out boundary of ±10 km in the Tohoku subduction zone. When this uncertainty is taken into account the location of serpentinite-out boundary almost overlaps with the lower plane of double seismic zone, suggesting that dehydration may be important in triggering intermediate-depth seismicity. In future studies, it will be possible to further constrain the thermal structure of subduction zones by including observations for individual subduction zone as additional constraints, and by limiting the regions from which data are used to constrain plate cooling models.

Keywords: subduction zone, oceanic plate, Bayes' inference, thermal structure