Crustal Thermal Structure of Japanese Island estimated from Heat Flow data

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When considering deformation in various scales, temperature is considered to be one of the most important physical parameters as well as stress, strain, and viscosity are. In this research, three-dimensional temperature structure under Japanese Island is estimated from the heat flow data. For the analysis, the heat flow data of about 3000 observation points are used. The heat transfer process that explains the observed heat flow data is expressed by the transient heat equation assuming a certain effect of the heat generation in the crust and the plate motion at the trench. Solution of that equation, obtained by ADI method (Alternating Direction Implicit Method), expresses the transient temperature structure. Total time length for the calculation is assumed to be 15Ma.

When considering deformation in various scales, temperature is considered to be one of the most important physical parameters as well as stress, strain, and viscosity are. In Japanese Island, which is characterized as one of the most active tectonic regions, the transient thermal structure and the heat transfer in the lateral direction associated with the hypocentral region of earthquake and the tectonics in the volcanic region have been discussed. In this research, three-dimensional temperature structure under Japanese Island is estimated from heat flow data.

For the analysis, heat flow data of about 3000 observation points, which have been compiled by ERI [Earthquake Research Institute, Tokyo University] are used after they are resampled with 0.5 degree interval by Bi-Cubic Spline.

The heat transfer process that explains observed heat flow data is expressed by the three-dimensional, transient heat equation assuming a certain effect of the heat generation in the crust and the plate motion at the trench. Solution of that equation, obtained by ADI method (Alternating Direction Implicit Method), expresses the transient temperature structure. Actual calculation of the simultaneous equations is done iteratively with the relaxation coefficient of 1.35. The grid interval is taken as 0.5 degree by 0.5 degree laterally, 1.5km vertically. As to each boundary condition, the temperature at 33km of one-dimensional thermal structure (Turcotte and Schubert, 1982) is assigned as the temperature at the lower-most plane. Referring Shiono (1992) and Hasegawa et al., (1983), the geometry of the vertical plane at the subduction boundary is constrained. And the temperature condition at that boundary is constrained by Plate Cooling model (Turcotte and Schubert, 1982.) The surface temperature is fixed to be 15 degree. For the other vertical plane at the boundary which temperature condition cannot be constrained from the other information, Neumann-type condition (heat flux is zero in the lateral direction) is assumed. Total time length for the calculation is assumed to be 15Ma considering the relatively young Philippine Sea plate.