Heat flow distribution and thermal structure in forearc areas

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Thermal structure of the forearc area is generally governed by heat transfer due to subduction of the oceanic plate. Previous studies revealed that the age of the subducting plate, subduction velocity and angle, and the sediment thickness at the trench are main controlling factors. In addition, radioactive heat production in the landward plate and frictional heating along the underthrusting plate boundary can also affect the temperature structure in the forearc significantly. Amounts of radioactive and frictional heating are unknown parameters, which may be estimated through comparison between the surface heat flow distribution calculated with numerical models and the observed data.

Studies on frictional heating along the plate boundary were previously made in some forearc areas where the surface heat flow distribution had been obtained. Most of them reported that the contribution of frictional heating to the surface heat flow is nearly negligible, which means that the frictional coefficient and the shear stress along the plate interface is very small.

We calculated thermal structures of some hypothetical forearc areas using a combination of analytical solutions, following Molnar and England (1990; 1995). We investigated how the thermal structure depends on various parameters, including frictional heating and radioactive heat production. It was found that contributions of frictional heating and radioactive heat production cannot be distinguished based on the surface heat flow profile. This uncertainty may give a relatively large error in estimation of the temperatures along the plate interface (seismogenic zone). It is important to obtain information on the distribution of radioactive heat production for better estimation of the thermal structure and frictional coefficient.