Thermal conductivity measurements of TCDP core samples and their interpretation

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Thermal conductivity measurements on the core samples from TCDP holes, Taiwan, were made using the standardized method by the authors. The main purpose of the present work is to assess what the effect of depth-wise distribution of in-situ thermal properties is, on the high resolution temperature gradient profile of the same site that was acquired independently. And also we have intended to establish the relationship of thermal conductivity with other physical properties which are routinely measured.

The total number of measurements amounts to more than 400 along the TCDP Hole-B with 1-m sampling intervals. For Hole-B, many different kinds of nondestructive measurements have also been made to cover all the intervals of cored depths, and particularly to characterize the fault zones presumably related to the big event of 1999 Chi-chi Earthquake (Hirono et al., in this JGU meeting). For the core samples of Hole-B, thermal conductivity(TC) measurement and bulk water content measurement by TDR method were always carried out simultaneously, in order to check whether the water/rock ratio of a given part of the formations is strongly controlling its thermal properties. If it is the case, we can formulate a conversion equation for the thermal conducutivity, based on water content as the primary parameter.

It is found, as we expected, that there is a very good negative correlation between TC and TDR water content for all the cored intervals of TCDP Hole-B. This result indicates that TC and TDR water content are controlled by a common mixing law with two constituent materials. Secondly, if we cross-plot the two quantities we can see some effects of different end-member properties for the solid grains, i.e. sand vs. shale/silt. Finally, we have converted the TC data into synthetic temperature gradient (dT/dz) profile, by assuming a constant value of heat flow from deep earth. From such a plot of synthetic dT/dz, we realize that it is very important to consider the long-wavelength changes of TC with depth, for correct understanding of the thermal behaviour of the formations. In connection with an attempt to detect the very small residual thermal energy causes by the frictional energy of past earthquakes, like the Chi-chi Earthquake, Taiwan, we should better start looking carefully at the conductive temperature profile which corresponds to the TC structure as we have obtained by direct measurement on cores.