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Pore Pressure Anomaly Inferred From Heat Flow and borehole pressure monitoring at the toe of Nankai Accretinary Prism off Muroto

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Seismogenic feature along subducting plate boundaries is largely controlled by the thermal structure, as well as material difference and hydrological parameters. Nankai accretionary complex is one of the well-known field of accretion-dominant tectonics, and heat flow data has been intensively collected using probes or estimated from gas hydrate BSR depths. Heat flow on the trough and near the frontal thrusts is almost twice as high as that predicted from the age of Shikoku Basin. This has been a long-standing question to be solved. One possibility is a focused fluid flow along decollement from deep, which carries heat also.

Kinoshita et al. (2003AGU) obtained a focused heat flow anomaly on the second frontal thrust. Its maximum anomaly is 130 mW/m2 and its width is less than 100m across the fault. Based on this result, we conducted a 2-D steady-state, hydrological simulation, including simplified decollement and frontal thrust. We defined a 100m-wide decollement at 700m beflow seafloor. Frontal thust with 100m width connects the decollement and the deafloor. Both zones have the same permeability Kch, whereas the surrounding area is set to have a lower and uniform permeability of 1e-17 m2. This simulates a focused fluid flow within the decollement-thrust system, induced by a pore pressure anomaly (dP, given as a boundary condition) at the landward end of decollement. Heat flow and Darcy velocity on the seafloor above the frontal thrust was calculated with over 100 different Kch and dP combinations.

We found that the observed maximum heat flow anomaly is proportional to the product of Kch and dP. According to Screaton et al. (2002) the possible pressure anomaly at decollement off Muroto ranges 0.07MPa to 4MPa. This leads to the possible range of Kch as 1e-13 to 1e-15 m2, using simulated empirical relationship above. They are consistent with previous estimates (e.g. Saffer et al. (1998)). Also this result may be compared with in-situ pressure observatory data by A-CORK (Davis et al. 2005). The best-fit Darcy velocity at the frontal thrust corresponding the heat flow anomaly of 130 mW/m2 is 2e-9 m/s. We also found that the calculated maximum heat flow anomaly is almost proportional to the maximum darcy velocity above the frontal thrust. This can be deduced from an analytical solution under a 1-D steady-state pore fluid regime.

These empirical relationships are integrated and compared with the equation of Darcy's law. Assuming a uniform pressure gradient within the permeable channel, this gives a rough estimate of the path length of permeable channel, which agrees well with the model. This suggests that most of the fluid in this case flow within the channel.