Basin analysis and Prediction of the development of anomalous fluid pressure at depths in the Western Foothills of Taiwan

***Wataru Tanikawa**

Tectonic Group, Depatment of Geology & Mineralogy, Graduate School of Sciences, Kyoto University

To evaluate fluid flow properties, such as permeability structure and porosity distribution, at depth of basins from the experimentally determined relationship between hydraulic parameters and effective pressure (Pe), we have to know the fluid pressure distribution. If abnormally high or low fluid pressure presents in the sedimentary basins fluid pressure is not equal to hydrostatics and the effective pressure would not be proportional to depth, therefore our experimental results could not simply be change to the depth – hydraulic parameter. In the Western Foothills of Taiwan, abnormally high fluid pressure exists at the depth from 3 to 4 km (Suppe and Wittke, 1977; Suppe et al., 1981), therefore we estimated this generation mechanism of anomalous fluid and fluid pressure distribution using experimental data.

We took sedimentary rocks from the outcrop in the Western Foothills of Taiwan, which is damaged by the 1999 Chi-Chi earthquake, and measured permeability and porosity as a function of Pe up to 200 MPa using the high-pressure apparatus at Kyoto University. Permeability decreased with increasing Pe and permeability did not fully recover during decompression. Permeability was generally the highest in conglomerate and the lowest in siltstone among conglomerate, sandstone and siltstone, which showed the permeability of 10-17 ~ 10-20 m2, 10-15 m2 ~ 10-18 m2 and 10-15 ~ 10-17 m2 respectively. Fault rocks showed similar value to siltstone. Sandstones were divided into two groups. Permeability of group Ⅰ did not change so much with increasing Pe. Group Ⅱ decreased with increasing Pe comparatively. Porosity also decreased with increasing Pe and showed hysteresis. Porosities decreased from 4% to 8% at the maximum Pe 200 MPa. We calculated specific storage using the porosity and pressure sensitivity. Specific storage decreased with effective pressure and the values changed from 10-8 Pa-1 at the lower Pe to 10-10 Pa-1 at the highest Pe 200 MPa.

The fluid pressure distribution of the Western Foothills was estimated by a non-linear one-dimensional compaction flow model in a sedimentary basin (Bethke and Corbet, 1988) using the permeability and specific storage as a function of Pe measured by experiments. The solution was shown as a relationship between fluid pressure and depth. The result indicated that abnormal fluid pressure was generated from 4,000m and increased with depth. Moreover this result showed similar trend to the logging data. This suggests that we could estimate the hydraulic constants at the depth using surface samples and the laboratory data. We also evaluated the permeability structure at depth of the Western Foothills.