Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SMP46-14 Room:304 Time:May 25 15:00-15:15

Correlation stress history with statistical analysis on mineral composition at small brittle fault in the borehole core

TANAKA, Nobuaki[1*], FUJIMOTO, Koichiro[1], SHIGEMATSU, Norio[2]

[1]Tokyo Gakugei University, [2]MEXT

The Median Tectonic Line (MTL), the largest on-land fault in Japan, has a long history of displacement, and the fault rocks deformed under variable conditions are distributed. The analysis of internal structure of the MTL, therefore, helps to improve our understandings of variable fault behavior depend on the physical conditions and development of fault zone.

AIST drilled a borehole penetrating the MTL for predicting Tonaikai-Nankai Earthquake at Iitaka, Matsusaka, Mie prefecture. The drilling length is 600m. It crosses MTL at the depth of 473.9m. Hangingwall of the MTL consists of Ryoke-derived tonalitic mylonite and footwall of the MTL consists of fractured rocks derived from Sanbagawa metamorphic rocks.

The rocks in the hangingwall experienced the four kinds of stress pattern after the mylonitization. These are stresses which caused normal faultings (vertical compressive stress (Stress-A) and North-South tensional stress (Stress-B), order of the two is unknown), North-South compressive stress and East-West compressive stress (present stress pattern) in turn with time (Shigematsu et al., oral presentation in the 117th Annual Meeting of the Geological Society of Japan, 2010). Among the 327 small brittle faults contributed to stress inversion on Shigematsu et al. (2010), 153 faults could be uniquely attributed to one of the four stress patterns, 127 faults could be attributed to two or three of them, and 47 faults belong to none of them (Tanaka et al., oral presentation in the 118th Annual Meeting of the Geological Society of Japan, 2011).

We tried to infer a suitable stress pattern each of those 127 faults from statistical analysis on the fault material on the slip surfaces of the small brittle faults.

We sampled the fault material on the 129 of those 153 faults, analyzed mineral composition of those samples by X-ray diffraction (XRD) and applied principle component analysis (PCA) to the 129 mineral composition data sets. As a result, an inverse relationship between quartz and carbonate was proved to be most significant characteristic. The fragmented wall rock is dominant in the quartz rich samples; in contrast, alteration minerals are dominant in the carbonate rich ones. Correlating among the four with removal of the carbonate rich ones, the newer (shallower) stress pattern is, the more carbonate content in fault material is. In the fault material, Stress-A contains less carbonate than Stress-B. Thus, the former may be older than the latter.

We sampled the fault material on the 113 of those 127 faults, analyzed mineral composition of those samples by XRD and applied discriminant analysis to the 113 mineral composition data sets. Assuming the stress pattern having minimum Mahalanobis' distance is valid, the 78 faults could be attributed to a suitable stress pattern. Combining the 153 faults and the 78 faults, the faults attributed to Stress-A and Stress-B are densely distributed from 140m to 250m depth, about 300m far from the MTL. In contrast, the faults attributed to the other two stresses are concentrated within 200m from the MTL. Thus, the width of the brittle deformation zone along the MTL might be narrower as regional uplifting and faulting.

Keywords: Median Tectonic Line, fault, borehole core, mineral composition, statistical analysis, stress history