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Fluid-rock interaction in subduction interface by geochemistry : Mugi melange,the Cretaceous Shimanto Belt, Shikoku, SW Japan

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It is suggested that the chemical reactions due to the fault activity or fluid-rock interaction along faults affect on mass and heat transfer, and physical property of rocks. This kind of chemical study has been still rare for fault rocks related to the subduction plate interface.

In this study, we divided lithofaces into host rock and altered rock in the melange zone of an on-land accrecionary complex. We defined melange as host rock because it was not cut by later brittle fault, and altered rock as fractured one related to the post-melange fault rocks. Then we analyzed chemical characteristics in each rock, and quantitative examination to understand change in chemical characteristics between deformation features.

The study area is the Mugi melange, the Cretaceous accretionary complex of Shimanto Belt, Shikoku, SW Japan. Analyzed fault rocks are located at the northern boundary of Mugi melange to the coherent unit of the Hiwasa formation(Minamiawa fault).

In the Minamiawa fault, we focused only on black shale and classified into three deformation features, melange(as host), breccia and gouge. Because it is considered that the melange is the primary deformation and later faulting may make breccia and gouge, we treated the melange as host rocks.

We measured a total of 25 elements, which are 10 major elements, 13 trace elements, H2O- and loss on ignition (LOI) by X-ray Fluorescence (XRF). In black shale, silica reduction with progressive deformation from host melange, breccia to gouge is clearly identified. The fact suggests that the deformation intensity is related to the silica reduction. Mapping of Electron Probe Micro-Analysis (EPMA) image was conducted on the melange host rocks, breccia and gouge. The results indicate that the silica reduction occurred within the pressure-solution and gouge. Within the gouge, the silica reduction localized in the very narrow zone, which suggests that the silica reduction might be due to the fluid-rock interaction after gouge formation.

Another chemical characteristic was also recognized. K2O, Fe2O3 and H2O- increase from host rock to altered rock in black shale. It is supposed that those three elements may be related to formation of clay minerals. In addition, the change in those elements from host rock to altered rock may be also related to the deformation intensity along fault zones within the subduction plate boundary.

By the way, it can be calculated fluid-rock ratios both in volume and weight within the fault zone using the silica reduction. And it is also calculated the fluid flux within the fault zone using geologic constraints (Goddard & Evans 1995). In this study, calculated F/R ratios are 102 - 103, and calculated fluid flux are 10-6-10-8 (m/s). The fluid flux of 10-9 -10-11 (m/s) in steady state, and 10-6-10-8 (m/s) in transient condition are reported by the simurated model in shallow part of subduction interface (Saffer & Bekins, 1998). Then, it is suggested that episodic fluid flow might cause the silica reduction from host rock to altered rock in subduction intereface.