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Migration of elements accompanied by the development of cataclasites in borehole penetrating the Median Tectonic Line

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Along the MTL which bounds the Ryoke shear zone and Sanbagawa belts the deformation was localized in the Ryoke shear zone with the decrease in the temperature. As a result, various fault rocks from mylonite to cataclasite were developed in the Ryoke shear zone. In the present study, the changes in volume and the element change were measured by the X-ray fluorescent analysis for the drilled core samples form the Iitaka Akou site. The drilling was conducted down to the Sanbagawa shear zone, 600m in total length. The fault rock samples used for the chemical analyses are from the drilling cores of 317m to 473m in depth. Hence, these samples all belongs to the Ryoke belt, and a host rock of the fault rock is tonalite. All the rocks experienced plastic deformation and became mylonite. Rocks suffered cataclasis as temperature decreased. To classify them by the degree of cataclasis, naked eye and thin section observations were conducted. As a result, the fault rocks were classified into four groups by the difference of the degree of cataclasis (nearly undeformed protolith, weakly deformed fault rocks, intermediately deformed fault rocks, strongly deformed fault rocks 'phyllonite'). Whole rock chemical compositions were analyzed by the X-ray fluorescent analysis to clarify the change in volume and chemical elements of these fault rocks, which were examined by the isocon method (Grant, 1986). In the present study, Al was used as an immobile element in fault rocks. Assuming that there was no density change of the fault rocks, the volume change can be estimated by the following equation. dV=[(1/S)-1]*100, where S is a slope of the straight line that connects the origin of isocon diagram with the plot of an immobile element. The element fluctuation rate can be calculated by the following equation for the change of each element. (Shikazono et al, 2007). Element fluctuation rate = (Elf/Alf)/ (Elh/Alh), where El is an arbitrary element, Al is an immobile element, and f and h are fault rocks and rocks of comparison, respectively.

The analyses by the isocon method were conducted for three kinds of combination. 'nearly undeformed tonalite and weakly deformed fault rocks', 'weakly deformed fault rocks and intermediately deformed fault rock', and 'weakly deformed fault rocks and strongly deformed fault rocks'. In the combination of 'nearly undeformed tonalite' and 'weakly deformed fault rocks', volume increases by 29.8 percent. Moreover, for the change of the major elements, K_2O (3.78), LOI (1.49), SiO_2 (1.46), Na_2O (1.28) increased, while TiO_2 (0.30), MgO (0.33), P_2O_5 (0.36), FeO+Fe_2O_3 (0.50), MnO (0.55), CaO (0.63) decreased. In the combination of 'weakly deformed fault rock' and 'intermediately deformed fault rocks', Volume decreases by 7.6 percent. Moreover, for the change of the major elements, TiO_2 (3.82), MgO (3.19), P_2O_5 (2.56), MnO (2.01), FeO+Fe_2O_3 (1.90), CaO (1.74), LOI (1.31) increased, while K_2O (0.76), Na_2O (0.80), SiO_2 (0.80) decreased. In the combination of 'weakly deformed fault rocks' and 'strongly deformed fault rocks', the volume decreased by 22.8 percent. Moreover, for the change of the major elements, MgO (8.76), TiO_2 (2.81), CaO (2.51), FeO+Fe_2O_3 (2.44), MnO (2.34), LOI (2.00), P_2O_5 (1.89) increased, and K_2O (0.60), Na_2O (0.56), SiO_2 (0.50) decreased. It is noted that the increase and decrease in the major element change show an opposite sense for 'nearly undeformed tonalite and weakly deformed fault rocks' and the other two combinations. The formation of new minerals correlated with the element change in the fault rocks is as follows. In the combination of 'nearly undeformed tonalite and weakly deformed fault rocks', an increase of K_2O corresponds to the formation of the muscovite and an increase of SiO_2 corresponds to the precipitation of quartz. In the other two combination an increase of CaO corresponds to the formation of calcite, and an increase of MgO and FeO+Fe_2O_3 corresponds to an increase of chlorite.