Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SSS25-13 Room:302 Time:May 21 12:15-12:30

Systematics of element migration via fluids in cataclasites and ultimate cataclasites by metasomatism

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We have analayzed mass transfer in cataclasites using core samples drilled through the Median Tectonic Line (MTL), Idaka-town, Mie-prefecture. This borehole penetrates through the MTL at the depth of c. 474 m, and the 20m thick lowermost part of the upper plate of the MTL belonging to the Ryoke belt is mostly composed of ultramylonite derived from tonalite. This ultra-mylonite experienced cataclastic deformation to various degrees, which can be divided into relatively non-, weakly, moderately and strongly deformed rocks based on the degree of cataclasis determined by the density of shear fractures. For all the samples (n=22), bulk chemistry was measured with XRF, and it has been found that the bulk chemistry of these rocks greatly changes with increasing degree of cataclasis. For this reason, the isocon diagram was constructed assuming Al as an immobile element for both sets, non-deformed rocks versus weakly deformed rocks, and weakly deformed rocks versus moderately or strongly deformed rocks. As a result, we have found the following facts. (1) During the increasing cataclasis from the non- to weakly deformed rocks, the mass increase of c. 25% occurred, and Si, Na and K increased, while Ca, Mg and Fe decreased. (2) During the increasing cataclasis from the weakly to moderately or strongly deformed rocks, the mass decrease occurred up to c. 25% for the strongly deformed cataclasites, and Ca, Mg and Fe increased, while Si, Na and K decreased. This means that the sense of element migration became reversed with increasing cataclasis. Further, since element migration in cataclasites resulted in the changes in volume fraction of constituting minerals, we analyzed the mineral mode of these using the point count method under an optical microscope. As a result, in the weakly deformed rocks, quartz veins were formed and plagioclase was sericitized, while in the moderately or strongly deformed rocks calcite veins were formed and chlorite was precipitated, correlated with the element migration in these rocks. Accordingly, the cataclasites derived from tonalite mylonite ultimately became calcite and chlorite rich rocks. These mass changes and element migration and resultant changes in constituting minerals were interpreted in the following way. From the non- to weakly deformed rocks, dilatancy occurred due to fracturing, and silica-rich fluids flowed into the pore space created by fracturing, and quartz was precipitated there. On the other hand, from the weakly to moderately or strongly deformed rocks, strong tectonic compression perhaps expelled the pore fluids, where a lot of silica was dissolved from quartz. However, why Ca, Mg and Fe, which were also perhaps dissolved in the pore fluids, were not precipitated as minerals in the weakly deformed rocks, but precipitated as calcite and chlorite, respectively in the moderately or strongly deformed rocks, remains to be unknown. Ca-metasomatism also occurs in mafic and ultramafic rocks, which is either accompanied by brittle deformation or not. In the future, the integrated research is necessary to clarify the process and mechanism of migration of Ca, Mg and Fe.

Keywords: element migration, metasomatism, cataclasite, volume change due to fracturing, dissolution and precipitation, isocon diagram