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Quantitative and microscopic analysis of deformed carbon minerals by Laser-Raman spectroscopy

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Mineralogical changes accompanied with seismic fault slip which has been considered that will not occur such a short duration has reported in this few years. These phenomena such as thermal decompisition (Han et al., 2007), thermal oxidation(Oohashi et al., 2009), change of crystal structure(Oohashi and Shimamoto, 2009), dehydration (Hirono et al., 2008) and amorphization (Brantut et al., 2008) are physico-chemical reaction derived from frictional heating and intense comminution with seismic slip, and must have controled by temperature and preexisted mineral assemblage. Investigation of these physico-chemical reaction is crucial for mass transfer, effect on mechanical behavior, energy budget and determination of seismic faulting. However, it is difficult to understand what happening on slipping zone materials quantitatively and continuously since the seismic slip in individual events may extremely localized within the thin zone(less than few mm). Meanwhile, Laser-Raman spectroscopy which capable of resolve into few micron is developed in recent, and is powerful method for microscopic analysis on principal slipping zone. On the other hand, author has reported carbon bearing fault rocks on several fault zones, and has been investigating mineralogical changes of carbonaceous materials during seismic-slip by high-speed friction experiment. Carbonaceous minerals has been used for temperature index of metamorphic rock, and it is well known that the Raman shift changes with increasing degree of graphitization (from D band of 1350cm^{-1}to G band of 1590cm^{-1}in wavenumber). Consequently, G/D ration is used for quantitative index of graphitization. Therefore, we conducted microscopic analysis using Laser -Raman spectroscopy to elucidate mineralogical(structural) changes on carbon minerals by faulting.
Graphitic cataclasite taken from Ushikubi fault, Atotsugawa fault system is used for analysis. Laser-Raman spectroscopy from undeformed flake graphite in host rock shows distinct G band Raman peak. Deformation of flake graphite become intense(like a mica fish) with close to the cataclasite band, and narrow graphite slipping zone(<1 mm) appears in central portion. In this slipping zone, Raman spectra include not only G band but also D band, and G/D ratio decrease. These observation shows anti-graphitization like process take place accompanied with cataclasis since D band is caused by existence of disorder or defect of graphite structure. These structural transform behavior of carbon minerals by faulting determined by Laser-Raman microscopic analysis can be a clue for determination of latest slip zone, degree of frictional heating and redox condition during faulting for carbonaceous fault zone.

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