EPMA Analysis and TEM Observation of Phyllosilicate Intergrowth/mixed-phase Using BSE Image

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Phyllosilicate minerals in chlorite, biotite and garnet zone metamorphic rocks of low to medium grade metamorphism at the Ogchon electron microprobe analyses(EPMA) and transmission electron microscope (TEM) Through diagenesis and low grade metamorphism of shale, it has been previously observed and confirmed that muscovite, chlorite, biotite, pyrophyllite and paragonite form mixed-layering (or intergrow) among each other. Mixed-layering/intergrowth of phyllosilicates are also observed in this study to generally occur in the medium grade (garnet zone, approximately up to 500℃) metamorphic rock. Chemical analysis (EPMA) data of single grains indicate mixing of two or three different minerals and these mixed-phase chemical data can be divided into reasonable component minerals such as biotite/chlorite/pyrophyllite, muscovite/chlorite/pyrophyllite, biotite/chlorite/muscovite or muscovite/pyrophyllite.

Muscovite, chlorite and biotite show different contrasts in back scattered electron (BSE) images and are intergrown each other at various scales Therefore. BSE images are useful in seach of mixed phase for the EPMA analysis and TEM study. A preminary observation of TEM lattice fring images of phyllisilocates reveals mixing of chlorite (14Å), muscovite(10Å) and/or biotite (10Å) in the scale of a 10 to 50 layers thickness. General occurrences of mixed-layering of phyllosilicates, as revealed in this study, in rather higher temperature metamorphism (garnet zone) imply that the reactions involved in the metamorphism of rocks in general are heterogeneous at a disequilibrium state, rather than homogeneous equilibrium as regarded until now.