Very Low Grade Metamorpism of Seismogenic Zone

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There are two end members of seismogenic zone in terms of the physical conditions. One is the low temperature type and another is high temperature type. The former is characterized by physical conditions of 2-5kb and 50 to 100 C but the latter is of 2-5kb and 200-400 C. The difference of physical conditions yields different mineral compositions in the plate boundary rocks of the seismogenic zone and thus it induces the mechanical behaviour of the plate boundary. In this paper, I will discuss the stability and evolution of mineral assemblages during subduction of plate boundary rocks along with slab.

Rocks of basic and pelitic compositions are investigated here. The mineral assemblages studied here are referred to natural systems of low grade metamorphic rocks of Izu-Tanzawa metamorphic area, of Shimanto metamorphic belt, and Sambagawa metamorphic belt. The very low grade zones are characterized by the mineral assemblages of zeolites, prehnite, pumpellyite, epidote, actinolite, chlorite, albite and quartz in basic compositions, and by the mineral assemblages of phengites, chlorite, albite and quartz in pelitic rocks. There are abundant relic minerals in basic rocks, including igneous augite, plagioclase and rarely glass.

The system of Ca-Al-Mg-Fe-Si-H-O in the low grade has been investigated by Arai and Toriumi (1988), including laumontite, prehnite, pumellyite, epidote, actinolite, chlorite, albite, hematite, and quartz. The invariant points in this system are prhenite-pumpellyite-hematite-laumontiite-actinolite-chlorite-quartz, prehnite-pumpellyite-actinolite-laumontite-hematite-chlorite-quartz in the very low grade pressure and temperature conditions.

Therefore, the possible mineral assemblages in the low temperature and high temperature type seismogenic zone are prehnite-laumontite-hematite-chlorite-quartz to prehnite-pumpellyite-hematite-chlorite-quartz and prehnite-laumontite-actinolite-chlorite-quartz to pumpellyite-prehnite-actinolite-chlorite-quartz, respectively. The reactions controlling the dehydration from the subduction slab and seismogenic zone are hematite + prehnite + chlorite = pumpellyite + quartz + water and hematite + prehnite + chlorite = pumpellyite + laumontite + water. In the high temperature regime, epidote formation from hematite, laumontite and prehnite and pumpellyite formation from prehnite, hematite and chlorite are induced. In the case of smectite instead of chlorite, the reactions and invariant points must be changed and in the lower temperature and pressure regions. The chemical compositions of chlorite in the lowest grade zones of Tanzawa show montmorillonite components, and thus this talk will be discussed about the effects.