The relationship between methane ratio to water and pressure-temperature in a deep (around 10km) subduction zone

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Fluids within the subduction zones are considered to influence on diagenetic process, transportation of material and heat, weakening of rock strength, chemical reaction, and unique biological environment. In this study, the methane ratio to water in deep subduction zone and its relation to P-T condition are examined using fluid inclusion trapped in mineral vein in the Cretaceous accretionary complex, Kii Peninsula, SW Japan. And then, we discuss about the fluid conduit from deep to shallow on the basis of the evidence about thermogenic methane reported from the shallow fluid.

The study area is the Miyama assemblage which is the Cretaceous Shimanto complex, Kii Peninsula, SW Japan. The Miyama assemblage is consisted of mainly sandstone and shale. They represent tectonic melange texture. Oceanic materials such as basalt and chert are abundant in this area. The basalt-chert unit is a good key layer to understand the map-scale geological structure. In the study area, map-scale geological structure shows the duplex consisted of four levels and tens of horses. The existence of the tectonic melange and duplex structure indicates that the study area record the deformation along subduction zone from underthrusting and underplating.

The veins are divided into two types. One is syn-melange vein which is developed only in sandstone blocks of melange and cut by shale matirix. Another one is post-melange vein which is observed along fault cutting melange fabrics.

P-T condition of vein developing is estimated by microthermometry of fluid inclusion. Two types of fluid inclusions are observed in one sample. One is methane inclusion. Another is water-rich inclusion. The coexistence of the two types of inclusions suggests that the fluid was a mixture of methane and water, which let an assumption that the water is saturated by methane at the time of trapping of the inclusions. Under the assumption, the homogenaized temperature indicates the trap temperature directly because the temperature is that of methane saturation to water. A homogenaized temperature of methane shows the methane density, and from the density, we can calculate isochore from P-T-V data. Combining the trap temperature and the isochore, pressure and temperature of trapping is estimated from one samples. In each sample, a number of inclusions of both methane and water are measured for homogenaized temperature. Estimated temperature ranges from about 150 degree C to about 270 degree C, and pressure ranges from about 80MPa to about 300MPa. The P-T range corresponds to the seismogenic zone suggested by thermal model.

The methane ratio to water is estimated from simply the ratio between numbers of methane inclusion and all inclusion. It is dangerous that the ratio indicates the composition of bulk fluid at the time of trapping, of course. However, considerable trend is found between methane ratio to water and P-T condition. The methane ratio increases with pressure and temperature increment. This means that the amount of methane is increase with P-T in the deep subduction zone.

Amount of water is roughly estimated from the vein density in Yokonami melange, the Cretaceous Shimanto Belt, Shikoku, Japan. According to the vein density, there is about 1cm quartz vein in every meter. If the fluid temperature was 200 degree C, about 237 times of volume of water is needed to dissolve the quartz. The water must migrate to shallow part. Methane concentration from deep subduction zone is reported from shallow decollement and landward slope of subduction zone. Such shallow methane may be originated from thee deep methane generated in the P-T condition estimated form in this study, that is seismogenic zone.