Fluid flow and its P-T condition along subduction interface: Example from the Cretaceous Shimanto Belt, Kii Peninsula, SW Japan

Yoshitaka Hashimoto[1], Mamoru Enjoji[2], Arito Sakaguchi[3], Gaku Kimura[4]

[1] Geological Institute, Univ. of Tokyo, [2] Inst. Earth Sci., Waseda Univ., [3] Natural Environmental Sciences, Kochi Univ., [4] Geol. Inst., Univ. of Tokyo

Understanding of fluid flow along subduction zone is a key to constrain the heat and material transfer and diagenetic process of sediment. In order to understand the fluid flow and its P-T condition along shallow subduction zone, we focused on veins in the Cretaceous Shimanto Complex, Kii Peninsula, SW Japan. The veins are classified into two types. One is associated with melange formation and the other is related to underplating. Fluid inclusion analysis was conducted for the veins to reveal the P-T condition of fluid. As a result, the P-T condition of fluid during melange formation ranges from about 150C to 210C and from about 90MPa to 230MPa. Those during or after underplating ranges from about 200C to 270C and from about 150MPa to 300MPa.

Fluid flow within the shallow subduction interface is a key to understand diagenesis process, and material and heat transfer. In this study, the time-spacio relationship between P-T condition of fluid and deformation process in shallow subduction zone from melange formation to duplexing is examined.

The studied complex is composed mainly of a melange of shale matrix enclosing sandstone, basalt, and chert blocks. Map scale structure represents duplex structure. Structural analysis clarified that the melange formation was related to underthrusting and duplexing resulted from underplating.

We classified the veins into two types on the basis of vein geometry and relationship with deformation fabric. Generation I veins fill extension cracks formed around the necks of boudinaged sandstones. This vein is strongly associated with melange formation. Generation II veins cut both through sandstone and mudstone. Generation II veins are observed predominantly along thrust faults. This fact suggests that generation II vein was formed during duplex-thrusting or thereafter.

To estimate P-T condition at the time of the vein formation, we measured fluid inclusion observed both in quartz and calcite veins. In all veins, there are two kinds of fluid inclusions. One kind has two phases (vapor and fluid) and the other has one phase (fluid). The composition of two-phase-inclusion is water-rich and one-phas-inclusion is methane-rich from the analysis by FT-IR. Combining heating and cooling experiments, the P-T condition of each vein is estimated. Temperature ranges from 150C to 220C (about +-25C) for Generation I vein and from 200C to 270C (about +-20C) for Generation II vein. Pressure ranges from 80.9 MPa to 235.1MPa (about +-10MPa) for generation I vein and from 144.8MPa to 303.7MPa (+-9MPa) for Generation II vein.

Because Generation I vein is strongly associated with melange formation, the P-T condition estimated from Generation I vein indicates that of melange formation.

Comparison between the studies of vitrinite reflectance and fluid inclusion analysis reveals a spacio-time evolution of the thermal structure.

The temperature estimated from vitrinite reflectance indicates the maximum paleotemperature of country rocks. Comparison between the temperatures estimated from vitrinite reflectance and fluid inclusion analysis represents that the temperature of fluid during Generation I vein formation is equal to or lower than that of country rocks, but the temperature of fluid of Generation II vein is equal to or higher than the temperature of country rocks. These observations suggest that the in situ fluid flow during melange formation and exotic and hot fluid migration along thrusts of duplex structure during or after underplating. The hot fluid migration did not affect the thermal maturation of shallow subduction zones because data of vitrinite reflectance has were not controlled by the hot fluid migration. This may be due to the short period of hot fluid migration.