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The regional and single-vein scale distribution of the CO2 fluids in the Shimanto accretionary complex, Muroto area, SW

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Carbon dioxide and methane are major carbonic components of the fluids in the crust. The crustal fluids generally have composition of C-H-O system, mainly composed of H_2O, CO_2, and CH_4, and they may be carried down into Earth's interior at subduction zones. Many studies have examined fluid components in various accretionary prisms under low-grade metamorphic conditions, and CH_4 is showed as the only carbonic species. Therefore, there is little information on the variation of the components of C-H-O fluids in subduction zones.

The Tertiary (Paleogene and Neogene system) Shimanto belt, southwest in Japan, is one of the best-studied ancient accretionary complexes. The Muroto Peninsula belongs to the Tertiary Shimanto belt, and it is mainly composed of sandstones, mudstones and conglomerates with small amount of basalt. Mineral veins were mainly composed of quartz, with small amount of calcite near the vein walls, while many studies have showed CH4 is the only carbonic component in the Shimanto belt, therefore it is unclear why calcite precipitated in the veins in absence of CO_2. Lewis (2000) reported the fluid inclusions of CH_4 and CO_2 mixture at one area in the Muroto Peninsula, but the extensive distribution of CO_2 fluids in the whole peninsula is not clear. In this study, we examined the distribution of C-H-O fluids from the Murotohanto Peninsula, as fluid inclusions in the mineral veins, using microthemometry and Laser Raman spectroscopy, in regional scale and single vein scale.

Fluid inclusions from quartz in the veins are composed of one-phase carbonic inclusions (only CH_4) and two-phase aqueous inclusions (carbonic vapor and H_2O liquid). Carbonic components of the vapor phase in the two-phase inclusions are gradually transited from CH4-dominant in the north area of the belt to a CO_2?CH_4 mixture in the south; the $CO_2/(CO_2 + CH_4)$ ratio in mole fraction (X_{CO2}) vary from 0 ˜0.3 in the north area to 0 ˜0.9 in the south.

In single vein scale, we examined single CO_2-bearing vein from the south area of the Peninsula, where X_{CO2} is 0 ˜0.8. The CO_2 ratio in the carbonic species is decreased from the vein wall (X_{CO2} = 0.5?0.8) to the vein center, in which carbonic species in the fluids is only CH_4 (X_{CO2} = 0). The existence of CO_2 only near the vein walls is in good agreement of the precipitation of calcite near the vein walls. The homogenization temperature increases from ˜180 ℃ to 240?250 ℃, indicating the transition of the carbonic species from CO_2?CH_4 to CH_4 during vein formation.

The dominant species of carbonic species in most accretionary prisms is CH_4 under low-grade metamorphic conditions, and thermodynamic calculation about equilibrium in the C-H-O fluids also shows that CH4 is dominant carbonic species in the equilibrium with graphite under the P?T conditions of formation of the CO_2-bearing veins (235?245 ℃, 165?200 MPa). The CO_2-fluids are preferentially distributed close to an out-of-sequence thrust that brings the Murotohanto sub-belt into contact with the late Oligocene?early Miocene Nabae sub-belt with its many volcanic lavas and intrusive rocks. Therefore, the CO_2-fluids were considered to be magmatic-origin, and that the fluids were injected and mixed with the CH_4pore-fluids of the sediments in the accretionary prism in the timing of formation of CO_2-bearing veins.

Keywords: fluid inclusions, accretionary complexes, calcite, mineral veins, C-H-O fluid, Shimanto belt